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THE MASSACHUSETTS STATE BUILDING CODE

USER'S GUIDE

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THE MASSACHUSETTS STATE BUILDING CODE

USER'S GUIDE

to

780 CMR

Sixth Edition

COMMONWEALTH OF MASSACHUSETTS

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THE USERS' GUIDE TO THE SIXTH EDITION

PART I - OVERALL CHANGES

The *Sixth Edition* of the Massachusetts State Building Code is based on the provisions of the 1993 BOCA National Building Code. However, since significant changes have been made to the national code, the *Sixth Edition* is considered a unique document to the Commonwealth. One should not assume that the two documents are compatible. There are several reasons for differences between the two codes, some of which are identified below.

(1) In some instances, requirements of Massachusetts General Laws (M.G.L.) conflict with provisions of the national code. Since law is superior to regulation, the national code must be stripped of any conflicting language.

(a) The Board of Building Regulations and Standards (BBRS) is fortunate to employ the services of various subcommittees comprised of learned and experienced professionals who donate their time in review of the code. Members of these subcommittees focus on certain aspects of the code and adapt its language to suit local peculiarities that may not be considered in the national code. These subcommittees include:

1. The Geotechnical Advisory Committee,
2. The Fire Prevention, Fire Protection Advisory Committee,
3. The Loads Advisory Committee,
4. The Seismic Advisory Committee, and
5. The Energy Advisory Committee.

Also, Massachusetts must coordinate the provisions of the state building code with the provisions of other specialized codes under the control of separate independent boards. Some of the specialized codes include:

6. The Fire Prevention Code (527 CMR),
7. The Elevator Code (524 CMR),
8. The Architectural Access Regulations (521 CMR),
9. The Plumbing and Gas Code (248 CMR), and.
10. The Electrical Code (527 CMR).

(b) The following chapters, are considered entirely unique to the Commonwealth differing significantly from the national code, and are so identified with a parenthetical statement below the chapter title. The chapters include:

Chapter 1 - Administration
Chapter 9 - Fire Protection Systems
Chapter 11 - Accessibility
Chapter 13 - Energy Conservation
Chapter 16 - Structural Loads
Chapter 18 - Foundations and Retaining Walls
Chapter 27 - Electrical Wiring and Equipment
Chapter 29 - Plumbing and Gas Fitting
Chapter 30 - Elevator and Conveying Systems
Chapter 34 - Repair, Alteration and Change of Use of Existing Buildings
Chapter 35 - Manufactured Buildings, Building Components and Mobile Homes
Chapter 36 - The One and Two Family Dwelling Code

(c) Changes in other chapters are identified with bolded, italicized face type.

(2) Part II of this Guide contains a summary of some of the major changes relative to the national code and to the *Fifth Edition* of the Massachusetts Building Code.

(a) The first change a user will note in the *Sixth Edition* of the code is the numbering system. Recently, three national code agencies joined forces in the hopes of someday producing a uniform, international building code. The first matter that these agencies agreed upon in this pursuit was to use a chapter format in lieu of the article system. Massachusetts has followed this lead.

(b) Recognizing the frustration that may develop in attempting to retrieve information utilizing this new system, a cross-index of article and primary section numbers of the *Fifth Edition* relative to the chapter and primary section numbers of the *Sixth Edition* is included as Part III of this Guide (again, please note that Part III is not meant as an absolute authoritative source identifying all changes from the *Fifth Edition* - refer to the actual code for definitive requirements).

PART II - SUMMARY OF CHANGES TO EACH CHAPTER

CAUTION

These summaries are meant as a transition tool for users of the *Sixth Edition* of the Massachusetts State Building Code and only highlight certain major changes. The summaries are not designed as an authoritative source for all changes either from the National Building Code or the *Fifth Edition* of the Massachusetts State Building Code. Always refer to the actual code documents for definitive requirements.

Part II of this Guide contains brief summaries of the major changes from BOCA National Building Code, and from the Fifth Edition of the Massachusetts State Building Code.

CHAPTER 1 - ADMINISTRATION

(Fifth Edition Article 1)

Differences from National Building Code:

Chapter 1 is considered unique to Massachusetts. Essentially it is a combination of *Fifth Edition* requirements and the national document.

Changes from the *Fifth Edition* of the Massachusetts State Building Code:

Some of the major changes in Chapter 1 occur in Section 105, which defines the qualifications and certification requirements for all those who serve as building code enforcement officials in the Commonwealth; Section 110.0, which delineates procedures for the placement of manufactured buildings (requiring a licensed construction supervisor to secure a permit for the work and a certified set crew to install the structure); Section 116.0, which more clearly defines the role of registered architects and professional engineers in the course of building construction; and Section 121.0 which defines the remedy available to person ordered to remove a dangerous structure (the route is through the courts, not through a board of appeals).

CHAPTER 2 - DEFINITIONS

(*Fifth Edition* Article 2)

Differences from the National Code

All definitions from the national code appear in this chapter. In a few instances, the wording was modified to reflect Massachusetts law or to clarify a definition. Also, some definitions specific to Massachusetts were added, such as inspector of buildings and local inspector.

Changes from the *Fifth Edition* of the Massachusetts State Building Code:

Although many definitions are provided for in Chapter 2, the national code chooses to separate others and place them within the chapter in which they most closely relate. For instance, words and terms specific to means of egress requirements are found in Chapter 10, not Chapter 2.

CHAPTER 3 - USE OR OCCUPANCY

(*Fifth Edition* Article 3)

Differences from the National Code:

Chapter 3 is compatible with the national code. However, portions of Section 313.0, *Mixed Use Groups*, are effected by changes that occur in Chapter 9 relative to fire suppression requirements of certain buildings.

Changes from the *Fifth Edition* of the Massachusetts State Building Code:

A feature added to the national code is found Section 302, which defines requirements for certain specific occupancy areas within buildings. Also, Section 307.0 describes four subclassifications for the *High Hazard Use Group Classification*, whereas, the *Fifth Edition* defines only one.

CHAPTER 4 - SPECIAL USE AND OCCUPANCY

(*Fifth Edition* Article 6)

Differences from the National Code:

Chapter 4 is consistent with the National Code from Sections 401.0 to 421.0 excepting changes incorporated due to conflicts with Massachusetts laws and\or regulations, such as those that occur in Section 603.0, defining the limits of high rise buildings, and Section 421.0, defining requirements for inground swimming pools.

Sections 422.0 through 429.0 are unique to the Commonwealth, defining special uses that do not appear in the national code. Some of these sections have been brought forward from the *Fifth Edition* of the code with little change; they include provisions for existing structures in Section 422.0, summer camps for children in Section 425.0, and detoxification centers in Section 428.0.

Sections 423.0, 427.0 and 429.0 which define special code provisions for group residences, limited group residences, and group dwelling units have been brought forward but have been modified to reflect new philosophies in the care of the occupants of these residences. These changes appear for the first time in the *Sixth Edition* of the code. The day care provisions in Section 424.0 have also been modified to increase occupant safety.

Possibly the most significant change to Chapter 4 appears in Section 426.0. This section defines requirements for bulk storage merchandising buildings. Such buildings contain sales areas with high piled combustible commodities, and\or hazardous materials. Inherently, these structures present different fire and life safety risks than traditional retail structures. Section 426.0 provides adequate safety to the patrons of these facilities and reduces the possibility of excessive property loss due to fire. The section is newly developed for the *Sixth Edition* of the code.

Differences from the *Fifth Edition* of the Massachusetts State Building Code:

Chapter 4 is significantly different than the compatible *Fifth Edition* of the code. To start, special use provisions are no longer found in Article 6, also several new provisions have been added such as those defined above, and more detailed requirements for high hazard uses.

CHAPTER 5 - GENERAL BUILDING LIMITATIONS

(*Fifth Edition* Article 5)

Differences from the National Code:

Chapter 5 is almost entirely compatible with the national code, excepting the addition of note *m* to Table 503 which cautions the code user to a distinction of Massachusetts general law requiring *hospitals, other than college or school infirmaries, to be erected of Type 1B construction or better.*

Changes from the *Fifth Edition* of the Massachusetts State Building Code:

Chapter 5 is very similar to the comparable *Fifth Edition* article. Methodologies relating to building size have remained constant for years, dating to work of insurance companies that originally developed the requirements. However, some requirements that appeared in the building limitations section of Article 5 have been moved to a more appropriate place. Provisions for accessibility, for instance are found in Chapter 11.

CHAPTER 6 - TYPES OF CONSTRUCTION

(*Fifth Edition* Article 4)

Differences from the National Code:

Chapter 6 is entirely compatible with the national code.

Changes from the *Fifth Edition* of the Massachusetts State Building Code:

Types of construction are located in Article 4 in the *Fifth Edition*. Location is the major change in the new code, some language is condensed relating to the description for the five types of construction.

CHAPTER 7 - FIRERESISTANT MATERIALS AND CONSTRUCTION
(*Fifth Edition* Article 9)

Differences from the National Code:

Chapter 7 is entirely compatible with the national code.

Changes from the *Fifth Edition* of the Massachusetts State Building Code :

Fireresistance rating of construction materials were located in Article 9 of the *Fifth Edition*. Along with location, several changes have occurred in the code text. Examples of change are found in Section 708.0 which limits opening sizes in fire wall assemblies, Section 713.0 which defines minimum fire resistance ratings for floor\ceiling and roof\ceiling assemblies in certain residential buildings, Section 717.0 which determines approval of fire dampers, and fire damper ratings, and 720.0 which requires the installation of firestopping and draftstopping.

CHAPTER 8 - INTERIOR FINISHES
(*Fifth Edition* Article 9)

Differences from the National Code:

Chapter 8 is entirely compatible with the national code.

Changes from the *Fifth Edition* of the Massachusetts State Building Code :

Interior finishes were part of Article 9 in the *Fifth Edition* under Sections 922.0 through 925.0. Since interior finishes can have a significant effect on a building's internal fire load. These provisions are separated in the *Sixth Edition* to emphasize the importance of properly regulating the placement of combustible trim, floor finishes, and interior hangings and decorations. Additionally, Section 806.0 limits the use of combustible materials in Types 1 and 2 construction. Chapter 8 should be utilized in concert with the provisions of 527 CMR, The Massachusetts Fire Prevention Code.

CHAPTER 9 - FIRE PROTECTION SYSTEMS
(*Fifth Edition* Article 10)

Differences from the National Code:

The provisions of Chapter 9 were developed by the *Fire Prevention\Fire Protection Advisory Committee* whose make-up is defined in the forward of the code.

Chapter 9 is significantly different than the national code and is considered unique to the Commonwealth, particularly in its requirements for fire suppression systems. Section 904.0 identifies where fire suppression systems are required in buildings based upon the building's size and use group classification.

Recognizing inherent life safety hazards posed by certain building types, and further recognizing the tremendous loss due to fire that has occurred in certain building types over the years, the *Sixth Edition* of the code requires fire suppression systems to be installed in buildings at levels not anticipated by the national code. For instance Section 904.2 of the national code, allows an assembly use, such as a motion picture theater, to be erected unsuppressed up to 12,000 square feet. The comparable *Sixth Edition* section requires a fire suppression system to be installed when it exceeds 8,000 square feet.

Also, Chapter 9 does not recognize the term *fire area*, which is often used in the pages of the national code. The term fire area is defined as *"the aggregate floor area enclosed and bounded by fire walls, exterior walls, or fire separating assemblies"*. Utilizing this concept in the design of mixed use buildings (Section 313.0 of the code) allows the code user to design and erect buildings that sacrifice fire suppression for fire resistive construction. Essentially, the result of such a design is a building that is (or may be) suppressed in one area, but not another. Such buildings may provide a false sense of security for the occupant; and cause logistical problems for fire service personnel who must fight the fire (ie: the firefighter does not necessarily know which portion of the building is fitted with a suppression system, and which is not; a fact he needs to know to adequately fight the fire or deal with the emergency). This is not to say that separated mixed used buildings are not an option under the new code. However, once the size of a building exceeds a certain dimension (dependent upon its use group), a suppression system is required, regardless of whether the uses are separated from one another with fireresitance rating construction, which may render the separated mixed use option irrelevant.

Changes to Chapter 9 are the result of many months of review of the national code. Some of the reasons for change are identified above. However, there are additional benefits to both the code user and the building occupant resulting from these changes. It is worth noting that many municipalities in the Commonwealth experience some difficulty developing and maintaining a properly staffed fire department, and are often challenged in fighting larger fires. With the changes in fire suppression requirements, some of the burden may be lifted from these departments.

Changes from the *Fifth Edition* of the Massachusetts State Building Code:

Chapter 9 has not only been relocated in the Sixth of the code, but has also been significantly changed in technical content. The format of Chapter 9 takes a more sobering look at issues of fire suppression and alarming and presents requirements in a more concise and logical pattern. It may be considered as different from *Fifth Edition* Massachusetts code as it is from the national code.

ARTICLE 10 - MEANS OF EGRESS

(*Fifth Edition* Article 8)

Changes from the National Code:

Chapter 10 is nearly compatible to the national code. Changes appear in limited sections.

The first change, an addition to the national code, occurs with the insertion of Section 1004.2 which empowers the building official to issue an *exit order* to a building owner when a hazardous egress condition is cited. Although this language is consistent with current practices in the Commonwealth, it is different from the requirements of the national code.

A second change occurs in Table 1010.3 of the code. Unlike the national code, the *Sixth Edition* only allows one means of egress from buildings in very limited instances (ie: use groups B and S-2 that meet ardent restrictions in terms of building size and occupant travel distance).

A third change appears in Section 1017.4.1 pertaining to the locking of egress doors. Actually, the section varies from the national code in two counts under this section. First, point number 8 under section 1017.4.1 allows for the locking of certain doors in I-1 and I-2 occupancies when other life safety concerns are at issue. Second, Section 1017.4.1.2 allows for special locking arrangements in certain business occupancies when security issues conflict with code requirements. In each of these instances, the code has responded to building owner needs, carefully balancing issues of security and life safety without to either. When egress doors are locked under these provisions, additional life safety features are required.

Additional changes are made to the provisions of Chapter 9 to ensure that it jibes with Massachusetts law and regulation.

Changes from the *Fifth Edition* of the Massachusetts State Building Code:

Many of the comments expressed above apply in respect to changes from the *Fifth Edition* Massachusetts code text. Means of egress requirements, in many instances, have changed and should be carefully reviewed by the code user.

CHAPTER 11 - ACCESSIBILITY

(*Fifth Edition* Section 512.0)

Differences from the National Code:

The provisions of Chapter 11 as they appear in the national code have been deleted. Chapter 11 in the *Sixth Edition* refers to 521 CMR, the *Rules and Regulations* of the Architectural Access Board (AAB regulations). The Architectural Access Board is empowered to promulgate these regulations under Massachusetts general law. Although it is a separate regulation under the control of a different agency, the provisions of the AAB regulations are enforced by municipal and state building officials. The code user is cautioned that there may be significant differences from the national code, and should refer only to 521 CMR for regulations pertaining to building accessibility.

Changes from the *Fifth Edition* of the Massachusetts State Building Code:

Reference to AAB regulations appeared in Section 512.0 of the *Fifth Edition* of the code. See above comments for changes.

ARTICLE 12 - INTERIOR ENVIRONMENT
(*Fifth Edition* - Article 7)

Differences from the National Code:

The *Sixth Edition* of the code requires all newly constructed buildings to mechanically ventilate bathrooms and toilet rooms (natural ventilation of such spaces is not allowed as a substitute for mechanical ventilation).

Access to attics and crawl spaces, if separating conditioned from unconditioned space, shall be weather-stripped and closed tightly.

Changes from the *Fifth Edition* of the Massachusetts State Building Code:

Bathroom mechanical ventilation requirements now include one- and two-family housing whereas the *Fifth Edition* of the code exempted one- and two-family housing bathrooms and toilet rooms from such required mechanical ventilation.

Access to attics and crawl spaces, if separating conditioned from unconditioned space, shall be weather-stripped and close tightly.

Rat-proofing requirements are now found in Chapter 12

ARTICLE 13 - ENERGY CONSERVATION
(*Fifth Edition* - Article 31)

Differences from National Code:

Chapter 13 of the Code does not yet require that new construction low-rise residential buildings conform to the requirements of the Council of American Building Officials (CABO) Model Energy Code, 1995 version (MEC95).

Chapter 13 will, however, require conformance to a Massachusetts version of MEC95 commencing March 1, 1998 - see front sheet of Chapter 13 and front of Appendix J.

One- and two-family housing now explicitly requires thermostats for each floor containing conditioned space.

Electrical outlet plate gaskets are now required on all receptacles, switch or other electrical boxes in walls separating conditioned from unconditioned space.

Changes from the *Fifth Edition* of the Massachusetts State Building Code

See "Differences from National Code" above.

CHAPTER 14 - EXTERIOR WALL COVERINGS
(*Fifth Edition* Article 21)

Differences from the National Code:

Chapter 14 is entirely compatible with the national code.

Changes from the *Fifth Edition* of the Massachusetts State Building Code:

Changes made relative to provisions for exterior walls are in respect to its location in the code and changes reflecting technological advances in anchoring systems and building material combustibility.

CHAPTER 15 - ROOFS AND ROOF STRUCTURES
(*Fifth Edition* Article 23)

Differences from the National Code:

Chapter 15 is entirely compatible with the national code, except, generic language referring to climactic conditions not relevant to the Commonwealth have been deleted.

Changes from the *Fifth Edition* of the Massachusetts State Building Code:

Changes made relative to provisions for roof and roof structures are in respect to location in the code and changes reflecting technological advances.

CHAPTER 16 - STRUCTURAL LOADS
(*Fifth Edition* Article 11)

Differences from the National Code:

The provisions of Chapter 16 were reviewed and further developed by both the *Loads* and the *Seismic Advisory Committees* whose make-up are defined in the forward of the code.

Wind load provisions have been simplified; snow load zones are considered unique to Massachusetts; the use of importance factors for snow load design is not utilized; seismic design is based on a peak velocity related acceleration (a_v) of 0.12 throughout the entire state; superfluous requirements dealing with loading criteria outside Massachusetts have been deleted.

Changes from the *Fifth Edition* of the Massachusetts State Building Code :

Seismic deign has been amended to reflect current design philosophy.

CHAPTER 17 - STRUCTURAL TESTS AND INSPECTIONS
(*Fifth Edition* Article 13)

Differences from the National Code:

The provisions are similar to the national code but are enhanced by requiring a specific program of testing and inspections of critical structural items to be developed by the Structural Engineer of record.

Changes from the *Fifth Edition* of the Massachusetts State Building Code:

This chapter has been clarified to identify critical inspection procedures for structural materials and processes and further serves to clarify some of the responsibilities of registered professionals under construction control (5th edition section 127 - 6th edition section 116)

CHAPTER 18 - FOUNDATIONS AND RETAINING WALLS
(*Fifth Edition* Article 12)

The provisions of Chapter 18 were reviewed and further developed by the *Geotechnical Advisory Committee* whose make-up is defined in the forward of the code. The following is a detailed analysis of the their work provided by members of the committee.

(1) For the *Sixth Edition*, the format, terminology and provisions of BOCA (1993) were usually adopted; the technical provisions are generally consistent with those in the *Fifth Edition* of the Massachusetts State Building Code, unless noted in the User's Guide. The User's Guide indicates the specific locations of significant changes which have been incorporated in the *Sixth Edition*, together with comments and backup information. Such changes include:

- (a) Technical changes to existing provisions, which may or may not be consistent with BOCA.
- (b) New provisions which have been adopted by the State Board of Building Regulations and Standards since issuance of the *Fifth Edition* (1990).
- (c) New provisions which are included in BOCA, but were not contained in the *Fifth Edition*.
- (d) New provisions which are introduced in the *Sixth Edition*.

All references herein to BOCA are to the BOCA National Building Code, 1993 (*Twelfth Edition*).

1802.0 FOUNDATION INVESTIGATIONS

1802.1 Where required: 1202.1 (Fifth Ed.) retained; BOCA requirements for specific number of borings for building area not adopted.

1802.1.1 Seismic investigation: criteria established for field investigation/report on evaluation of "liquefaction" potential, with reference to Section 1805.3 (1612.3 in the Fifth Ed.)

1802. 2 Soil samples and boring reports: provisions of 1202. 2 (Fifth Ed.) retained, which require that copies of the results be filed with the code official.

1803.0 SOIL BEARING TESTS

1803.0 Soil bearing tests: all of 1203.0 (Fifth Ed.) retained; in lieu of 'Soil test procedure'.

1804.0 LOAD BEARING VALUE OF SOILS

1804.1 Soils report: 1201.3.2 (Fifth Ed.) provisions retained; BOCA list of requirements for prepared fill in report are not included.

1804.2 Satisfactory foundation materials: 1201.2 (Fifth Ed.) retained.

1804.3 Presumptive load bearing values: 1201.3 (Fifth Ed.) provision for approval of higher bearing pressures retained, and 1201.3.1 reference to Appendix for guidelines for classification of bearing materials retained.
TABLE 1804.3 Allowable Bearing Pressures, has been retained from the Fifth Ed. (TABLE 1201) with some minor modifications.
The values in BOCA (TABLE 1804.3) are considered inappropriate for Massachusetts.
1201.3.2 (*Fifth Ed.*) provisions for compacted fill below foundations and for field control are retained.

1804.4 Lightweight structures: 1201.3 (Fifth Ed.) retained.

1805.0 ALLOWABLE FOUNDATION LOADS

1805.2 Soil capacity: Provision added, which allows up to 33% increase in bearing pressures for soil types indicated, for load combinations which include wind or seismic. This provision applies to all foundation types. A similar provision in the Fifth Ed. (1206.2) that applied only to footings has been deleted.

1805.3 Liquefaction: These provisions have been transferred in their entirety from 1113.8 (Fifth Ed.).

1805.4 Vertical pressure: 1204.4 (Fifth Ed.) retained.

1805.5 Settlement analysis: 1204.5 (Fifth Ed.) retained.

1805.6 Disturbance of bearing soils: 1204.6 (Fifth Ed.) retained.

1805.7 Rock foundations: provisions added for increased bearing pressures, based on load tests (per BOCA).

1806.0 DEPTH OF FOOTINGS

1806.1 Frost Protection: modified to apply to structures larger than 100 sq. feet area or 10 feet high (per BOCA).

1806.2 Isolated footing: The criteria for relative position of soil-bearing footings changed, consistent with BOCA (See 1205.2, Fifth Ed.).

1806.3 Depth of spread footings: 1205.3 (Fifth Ed.) retained.

1807.0 FOOTING DESIGN

1807.1 Design loads: 1206.1 (Fifth Ed.) retained.

1807.4 Eccentric loads: 1206.6 (Fifth Ed.) retained.

1810.0 CONCRETE FOOTINGS

1810.2.1 Footing seismic ties: Requirements for seismic ties between footings for Category D structures have been added consistent with BOCA (1810.2.1). These provisions differ from BOCA in that the ties are to be designed for a force equal to 10% of the larger column dead load plus live load in lieu of "a force equal to 25% of the effective peak velocity-related acceleration (A_v) times the column dead load plus live load". Under 1113.6.9 (Fifth Ed.) interconnections of footings with ties were not specifically required, but were to be considered in the design.

1812.0 FOUNDATION WALLS

1812.2 Definitions and 1812.3 Minimum thickness: definitions have been added and requirements modified from those of 1222.2 (Fifth Ed.); also, Table 1812.3.2 has been changed.

1812.6 Lateral stability: there is an added reference to 1825.0 for seismic design requirements.

1814.0 MAT RAFT AND FLOAT FOUNDATIONS

1814.2 Settlement analysis: the requirement for a settlement analysis (1211.2, Fifth Ed.) is retained.

1815.0 PIER FOUNDATIONS

1815.1 General: The definitions, as given in 1212.1 (Fifth Ed.) are retained but with modifications: 1) "and piles installed by the hollow stem auger method" is deleted (refer now to 1820.2) and 2) "other non-circular foundation elements" are now included.

1815.2.1 Foundation ties: the provisions for interconnection between piers are consistent with BOCA (1815.2), except that the ties are to be designed for a force equal to 10% of the larger column dead load plus live load in lieu of "a force equal to 25% of the effective peak velocity-related acceleration (A_v) times the column dead plus live load". (This in effect retains the requirement in 1113.6.9 (Fifth Ed.) for interconnection of piers, with a similar magnitude of design force in the tie, which is more conservative than BOCA.)

1815.2.2 Seismic reinforcement: these new provisions are similar to those now required for cast-in-place concrete piles (see 1820.1.2.1). The provisions in 1820.1.2.1 which were adopted by BOCA, are consistent with the model code provisions issued by FEMA (*NEHRP Recommended Provisions for Seismic Regulations for New Buildings*, 1994 Edition, prepared by the Building Seismic Safety Council for the Federal Emergency Management Agency). Although BOCA does not require seismic reinforcement for piers, it is noted that the FEMA guidelines recommended that the same seismic provisions apply to drilled piers or caissons. Therefore, such provisions are included herein. Note that the "minimum pier design cross sectional area" is defined as the minimum section area, as determined by the allowable design stresses, even though the actual pier section may be larger.

1815.2.3 Pier cap connection: the provisions are similar to those now required for all concrete piles (1816.11.1) which are consistent with the FEMA model code provisions (see 1815.2.2 for reference). Although BOCA does not require the cap connection for piers, such provisions are included herein for consistency with the FEMA recommendation.

1815.2.4 Alternative detailing: This provision allows alternatives to the code-specified minimum reinforcing, similar to the BOCA provision for concrete piles in 1816.11.1.

1815.3 through 1815.11: The existing provisions, in 1212.2 through 1212.10 (Fifth Ed.) are retained; they are considered more complete and appropriate for Massachusetts.

1816.0 PILE FOUNDATIONS

1816.3 Pile bending seismic design: The special provisions of BOCA (1816.3) were adopted for pile reinforcement below buildings assigned to Seismic Performance Category D; this was not required in the *Fifth Edition*. It is noted that this is consistent with the FEMA document referenced in 1815.2.

1816.4 Protection of pile materials: the existing provisions, 1213.3 (Fifth Ed.) are retained; they are considered more complete and appropriate for Massachusetts.

1816.5 Lateral support: 1213.4 (Fifth Ed.) is retained; reference to "fluid soil" is deleted.

1816.7 Stability: 1213.6 (Fifth Ed.) is retained.

1816.8 Structural integrity: 1213.7 (Fifth Ed.) is retained.

1816.10 Splices: 1213.9 (Fifth Ed.) retained, including requirement for all pile splices to "develop at least 50% of the capacity in bending". In addition, the BOCA provisions for design requirements for splices located in the upper ten feet of the embedded pile are adopted.

1816.11.1 Pile cap seismic connection: The special provisions of BOCA (1816.11.1) were adopted for seismic connection of all concrete piles to the caps (not required in Fifth Ed.). Note: This is a new requirement, which may have an economic impact on pile foundations.

1816.11.2 Pile foundation seismic ties: The provisions for interconnection between pile caps are consistent with BOCA (1816.11.2), except that the ties are to be designed for a force equal to 10% of the larger column dead load plus live load in lieu of "a force equal to 25% of the effective peak velocity-related acceleration (A_v) times the column dead plus live load". (This in effect retains the requirements in 1113.6.9 (Fifth Ed.) for interconnection of pile caps; the magnitude of the design force in the tie is more conservative than BOCA.)

1816.13 Inspection: The more detailed requirements of 1213.12 (Fifth Ed.) are retained.

1816.18 Pile Heave: The more detailed requirements of 1213.17 (Fifth Ed.) are retained.

1817.0 ALLOWABLE PILE LOADS

1817.1 through 1817.3: The existing provisions in 1214.1, 1214.2 and 1214.3 (Fifth Ed.) including the requirements for determination of allowable load by the driving formula, friction formula in clay and for jacked piles, are retained. (Note: The description of the design criteria for friction piles in clay has been modified for clarification.

1817.4 Compression load test: The existing provisions in 1214.4 (Fifth Ed.) are retained; they are more detailed and appropriate for local conditions.

1817.6 Lateral load tests and 1817.7 Tension Load tests: The more detailed existing provisions of 1214.6 and 1214.7 are retained.

1817.8 Bearing capacity: The existing provisions of 1214.8 (Fifth Ed.) are retained.

1818.0 STRUCTURAL STEEL PILES

1818.2 Allowable stress: The existing provisions in 1215.4 (Fifth Ed.) are retained, including the limit of "35% of the minimum specified yield strength or 12,600 psi." The limitation on stress is a result of driveability considerations.

1818.3 Pile cap seismic connection: The special provisions of BOCA were adopted for connection of steel piles to the caps for buildings assigned to Seismic Category D, (not required in the *Fifth Edition*).

1819.0 CONCRETE-FILLED STEEL PIPE AND TUBE PILES

1819.2 Allowable stress: A distinction is made between top-driven and mandrel-driven piles:

- In 1819.2.1, the existing provisions in 1216.3 (Fifth Ed.) for stress limits due to driveability considerations are retained for top-driven piles.
- In 1819.2.2, the higher allowable limits in BOCA are allowed for piles driven by mandrels which effectively transmit the driving stresses to the bottom of the pile.

1819.3.1 Pile cap seismic connection: The special provisions of BOCA were adopted for pile reinforcement and connection to the cap for all piles (not required in the Fifth Ed.).

1819.5 Placing concrete: the existing provisions in 1216.1 (Fifth Ed.) for alignment criteria of the steel pipe before filling with concrete have been deleted; the reason is that other pile types which cannot be similarly inspected are not subject to such requirements, and such requirements are not generally necessary.

1820.0 CAST-IN-PLACE CONCRETE PILES

1820.1.1 Material: The existing requirement, 1217.1 (Fifth Ed.) for minimum concrete strength is retained (i.e. 3000 psi in lieu of 2500 psi in BOCA)

1820.1.2.1 Seismic reinforcement: The special requirements of BOCA (1820.2.2.1) for pile reinforcement and connection to the cap are adopted (Not required in Fifth Ed.). Note: There are different requirements for buildings assigned to Seismic Performance Category C and D.

1820.1.3 Installation: the installation requirement for all cased, concrete-filled piles are given here, and are referenced in 1820.4.3.2.3 and 1820.5.3.

1820.2 Augered uncased piles: The provisions are now in a new, separate section; this pile type was previously (Fifth Ed.) included in 1212.0 Pier foundations. The provisions have been modified, and are not entirely consistent with BOCA (1820.2).
Note: 1820.2.8 Instrumentation has been added; it requires that the auger rig be equipped with data logging equipment to automatically record vital information during installation.

1820.4 Pressure-injected footings: All provisions are those contained in the REVISIONS to 1217.0 (Fifth Ed.) which were adopted since issuance of the *Fifth Edition* (1990). The revisions, together with an extensive Commentary, were prepared by the Geotechnical Advisory Committee and presented at a Public Hearing on November 30, 1993, and were subsequently approved and filed by the State Board of Building Regulations and Standards.

1820.5 Cased poured concrete piles: The existing provisions in 1217.5 (Fifth Ed.) have been retained, including the limitation of 1,600 psi on design stress.

1820.6 Small diameter grouted piles: These provisions for grouted cast-in-place piles, less than 12 inches diameter, are not included in BOCA (1993). The requirements of 1217.2 (Fifth Ed.) have been re-organized and retained.

1821.0 PRECAST CONCRETE PILES

1821.1 through 1821. 3: The BOCA provisions are generally adopted. In 1821.33, the formula for design compressive stress varies slightly from that in 1218.3 (Fifth Ed.) i.e., a smaller deduction is required for the prestress. The 1600 psi limitation on design stress in the Fifth Ed. has been retained.

1821. 3. 5 Pile cap seismic connection: The special provisions for seismic connection (per 1816.11) also allows for extension of the pile reinforcing strand into the cap, except for buildings assigned to Seismic Performance Category D.

1821.3.6 Spiral seismic reinforcing: Special BOCA provisions for the length of spiral reinforcement for buildings assigned to Seismic Performance Category D are adopted. Also, the requirements for ties in the upper two feet of pile have been added, to be consistent with FEMA.

1822.0 TIMBER PILES

1822.1 through 1822.4: All provisions are those contained in the REVISIONS to 1219.0, which have been adopted since issuance of the *Fifth Edition* (1990).

The Revisions, together with an extensive Commentary, were prepared by the Geotechnical Advisory Committee and presented at a Public Hearing on November 8, 1994, and were subsequently approved and filed by the State Board of Building Regulations and Standards.

1824.0 CONCRETE-FILLED STEEL PIPE WITH STEEL CORE CAISSONS

1824.2 Rock socket: The provisions for the rock socket design have been revised to require that the perimeter bond stress be determined by studies for each installation, but in no case shall the bond stress exceed 200 psi. Also, the minimum outside diameter has been reduced from 24 to 18 inches, consistent with BOCA.

1824.3 Seismic reinforcement: It is required that all caissons have seismic reinforcement, per 1820.1.2.1 (not in *Fifth Edition*)

1824. 6 Allowable stress: BOCA provisions adopted, without the stress limits on concrete and steel as contained in 1221.8 (Fifth Ed.); such limits do not apply, since the caisson is not driven.

1824.8 Precautions: The requirement for plumbness (1221.6 Fifth Ed.) has been deleted.

1825.0 RETAINING WALLS

1825.2 Design: Design requirements to resist seismic loads have been added.

CHAPTER 19 - CONCRETE

(*Fifth Edition* Article 15)

Differences from the National Code:

The provisions are essentially the same as the national code.

Changes from the *Fifth Edition* of the Massachusetts State Building Code:

Seismic requirements for reinforced concrete have been amended to reflect current design and construction practices consistent with expected seismicity of the region.

CHAPTER 20 - LIGHTWEIGHT METALS

(*Fifth Edition* Article 19)

Differences from the National Code:

The provisions are the same as the national code.

Changes from the *Fifth Edition* of the Massachusetts State Building Code:

No changes from 5th edition other than updating of referenced standards.

CHAPTER 21 - MASONRY

(*Fifth Edition* Article 14)

Differences from the National Code:

The provisions are essentially the same as the national code with the exception of reinforcing requirements.

Changes from the *Fifth Edition* of the Massachusetts State Building Code:

Seismic requirements for masonry have been amended to reflect current design and construction practices consistent with expected seismicity of the region

CHAPTER 22 - STEEL

(*Fifth Edition* Article 18)

Differences from the National Code:

The provisions are essentially the same as the national code with the exception of the inclusion of the provisions of the "Interim Guidelines for Steel Moment Frame Structures" (FEMA 267 - August 1995).

Changes from the *Fifth Edition* of the Massachusetts State Building Code:

Seismic requirements for steel have been amended to reflect current design and construction practices consistent with expected seismicity of the region.

ARTICLE 23 - WOOD

(*Fifth Edition* Article 17)

Differences from the National Code:

The provisions of Chapter 23 are essentially the same as the national code with the exception of the inclusion of text for the use of native lumber.

Changes from the *Fifth Edition* of the Massachusetts State Building Code:

Seismic requirements for wood construction have been amended to reflect current design and construction practices consistent with expected seismicity of the region.

CHAPTER 24 - GLASS AND GLAZING

(*Fifth Edition* Article 22)

Differences from the National Code:

Chapter 24 reflects the provisions of the 1996 national building code, and is different only to remain compatible with Massachusetts general law.

Changes from the *Fifth Edition* of the Massachusetts State Building Code:

The requirements for glass and glazing have been relocated in the *Sixth Edition* of the code, and have been modified to reflect advances in technology.

CHAPTER 25 - GYPSUM BOARD AND PLASTER

(*Fifth Edition* Article 16)

Differences from the National Code:

Chapter 25 is entirely compatible with the national code.

Changes from the *Fifth Edition* of the Massachusetts State Building Code :

The requirements for gypsum board and plaster have been relocated in the *Sixth Edition* of the code, and have been modified to reflect changes in technologies.

CHAPTER 26 - PLASTIC

(*Fifth Edition* Article 20)

Differences from the National Code:

Chapter 26 is entirely compatible with the national code.

Changes from the *Fifth Edition* of the Massachusetts State Building Code:

The requirements for plastic have been relocated in the *Sixth Edition* of the code, and have been modified to reflect changes in technologies.

CHAPTER 27 - ELECTRICAL WIRING AND EQUIPMENT

(*Fifth Edition* Article 27)

Differences from the National Code:

Chapter 27 has been deleted from the national code in its entirety. Electrical wiring and equipment is regulated by a separate state agency, and is made part of the code by reference.

Changes from the *Fifth Edition* of the Massachusetts State Building Code:

See comments above.

CHAPTER 28 - MECHANICAL SYSTEMS
(*Fifth Edition* - Article 25)

Differences from National Code:

Chapter 28 of the *Sixth Edition* of the code contains Section 2812.0 which sets forth requirements for power venters and acknowledges other jurisdictions which also regulate the installation of power venters (Board of Fire Prevention Regulations for oil-fired appliances; see 527 CMR and the Plumbing and Gas Board for gas-fired appliances; see 248 CMR).

Changes from the *Fifth Edition* of the Massachusetts State Building Code:

Explicit construction requirements for boiler rooms have been removed from the *Sixth Edition* of the Massachusetts State Building Code.

CHAPTER 29 - PLUMBING SYSTEMS
(*Fifth Edition* - Article 28)

Differences from National Code:

Massachusetts plumbing and gas requirements are controlled by the Plumbing and Gas Code - 248 CMR and promulgated by the Plumbing and Gas Board and such requirements are typically not controlled by the State Building Code.

Changes from the *Fifth Edition* of the Massachusetts State Building Code:

Chapter 29 now also identifies Massachusetts laws and regulations that involve licensed refrigeration technicians and pipefitters.

ARTICLE 30 - ELEVATORS
(*Fifth Edition* - Article 26)

Differences from National Code:

Massachusetts elevator requirements are controlled by the Elevator Regulations - 524 CMR, promulgated by the Board of Elevator Regulations and such requirements are typically not controlled by the State Building Code.

Changes from the *Fifth Edition* of the Massachusetts State Building Code:

The detailed requirements set forth in the *Fifth Edition* of the State Building Code have been removed to ensure clarification of the jurisdiction of both the Board of Building Regulations and Standards and the Board of Elevator Regulations.

CHAPTER 31 - SPECIAL CONSTRUCTION
(*Fifth Edition* Articles 6, 21, 19 and 30)

Differences from the National Code:

Chapter 31 is essentially the same as the national code. However, substantive changes have been made to the Flood Resistant Construction provisions of Section 3107.0. Additional changes have been made to remain compatible with Massachusetts general law and regulation.

Changes from the *Fifth Edition* of the Massachusetts State Building Code :

Requirements in Chapter 31 were scattered about the pages of the *Fifth Edition*. They have been organized in a more logical fashion in Chapter 31, and have been modified to reflect advances in technology. Also see comments above.

CHAPTER 32 - CONSTRUCTION IN THE RIGHT-OF-WAY
(*Fifth Edition* Articles 7 and 30)

Differences from the National Code:

Chapter 32 is essentially the same as the national code, changed only remain compatible with Massachusetts general law and regulation.

Changes from the *Fifth Edition* of the Massachusetts State Building Code:

Requirements in Chapter 32 were scattered about the pages of the *Fifth Edition*. They have been organized in a more logical fashion in Chapter 32, and have been modified to reflect advances in technology.

CHAPTER 33 - SITE WORK, DEMOLITION AND CONSTRUCTION

(*Fifth Edition* Article 30)

Differences from the National Code:

Chapter 33 is essentially the same as the national code, changed only remain compatible with Massachusetts general law and regulation.

Changes from the *Fifth Edition* of the Massachusetts State Building Code :

Requirements in Chapter 33 have been organized in a more logical fashion and have been modified to reflect advances in technology.

CHAPTER 34 - REPAIR, ALTERATION, ADDITION AND CHANGE OF USE OF EXISTING BUILDINGS

(*Fifth Edition* Article 32)

Differences from the National Code:

Chapter 34 has been substantially modified from the national code in terms of technical content and format.

Changes from the *Fifth Edition* of the Massachusetts State Building Code:

The requirements for the repair, alteration, addition and change of use for existing buildings have been modified from the provisions of Article 32 and presented in a more logical fashion. Section 3408.0 presents structural requirements for existing buildings that are new to both Massachusetts and the national code.

Additionally, Chapter 34 differs from the *Fifth Edition* of the code in several ways, including:

(1) Guidance on unsafe lighting and/or unsafe ventilation is now presented in Chapter 34;
(2) A definition for "substantial renovation" is provided;
(3) Emphasis of the need for an evaluation of existing buildings that fall under the requirements of "controlled construction" is provided;
(4) Requirements for continuation of the same use group or a change to a use group resulting in a change in Hazard Index of one or less have been combined;
(5) Clarification as to when Fire Protective Systems are required, is provided;
(6) Energy provisions for any existing building undergoing building permittable work are provided and clarified and will further change (there will be an impact on "replacement windows" on January 1, 1999) - see the front piece to Chapter 13 which is also repeated as the front piece to Appendix J;
(7) Structural requirements for existing buildings are now delineated;
(8) "Historic Buildings" requirements are now found in Chapter 34, whereas in the *Fifth Edition* of the Code, "Historic Buildings" criteria was found in Article 6.

CHAPTER 35 - MANUFACTURED BUILDINGS, MANUFACTURED BUILDING COMPONENTS AND MANUFACTURED HOUSING

(*Fifth Edition* - Article 33)

Differences from National Code:

Chapter 35 in concept and specific requirements is unique to Massachusetts.

Changes from the *Fifth Edition* of the Massachusetts State Building Code:

Chapter 35 of the *Sixth Edition* of the State Building Code differs from Article 33 of the *Fifth Edition* of the Code in several ways, including:

(1) A definition of the "Installer of Manufactured Homes" has been created, and;
(2) Construction documents requirements have been clarified, and;
(3) The homeowner exemption for the acquiring of the building permit has been removed and it is now necessary for a licensed construction supervisor to apply for the permit, oversee site, footing and foundation work and if the licensed construction supervisor is also an "Installer of Manufactured Homes", the license holder may/shall also oversee installation of the Manufactured Home onto the foundation system and ensure proper tying of the various modular units together before turn over to the

Homeowner, otherwise in addition to the license holder being involved, a factory certified "Installer of Manufactured Homes" shall be present to ensure proper installation and bolt-up of the Manufactured Home before turn over to the Homeowner.

CHAPTER 36 - ONE AND TWO FAMILY DWELLING CODE
(*Fifth Edition* - Article 34)

Differences from National Code:

Chapter 36 utilizes the general format of the CABO ONE AND TWO FAMILY DWELLING CODE, 1995 EDITION, but is significantly altered throughout to reflect Massachusetts requirements.

Changes from the *Fifth Edition* of the Massachusetts State Building Code:

Chapter 36 of the *Sixth Edition* of the State Building Code differs from Article 34 of the *Fifth Edition* of the Code in a number of ways, including:

(1) In the Definitions section, DMR Group Homes are defined in terms of the Residential Use they most likely resemble (R-4, R-3, R-2 or R-1, as applicable), and:

(2) the Uniform Snow Load Maps have been clarified by city or town, and;

(3) attached garage fire separation from the main house has been redefined, and;

(4) mechanical ventilation of bathroom and toilet rooms is now required, and;

(5) clarification of the venting of special spaces, such as roofs, eaves, etc. reflects the requirements of the main body *Sixth Edition* Code, and;

(6) attic access between conditioned and unconditioned space is explicitly required to be weather-stripped and pull-down doors must close tightly, and;

(7) the fire protections systems requirements for one and two family dwellings has been refined to reflect the requirements of Massachusetts and NFPA-72, (photo-electric smoke detectors and the battery backup of all single station and multiple station smoke detectors are addressed) and;

(8) energy conservation requirements, although not yet significantly changed (thermostats are now required on every story that contains heated and/or cooled space)l, will change on March 1, 1998 to reflect requirements of Massachusetts and the CABO Model Energy Code, 1995 version - see the front piece to Chapter 13 which is also repeated as the front piece top Appendix J, and;

(9) Span tables have been updated and expanded , and;

(10) The fireplace, chimney and solid fuel-burning appliance requirements have been updated to Massachusetts requirements, and;

(11) Recognition of the multiple jurisdictions and regulations pertaining to the design and installation of comfort heating appliances has been placed in Chapter 36; i.e., in addition to the State Building Code (780 CMR), the Plumbing and Gas Code (248 CMR) and the Fire Prevention Regulations (527 CMR) also are identified, and;

(12) Solar system criteria is also found in Chapter 36.

DESCRIPTION OF APPENDIX J

Appendix J, "Energy Conservation for Low-Rise Residential Buildings" is currently unique to Massachusetts and is referenced from Chapter 36. Appendix J carries forward the current *Fifth Edition* energy conservation requirements with minor changes, including the requiring of thermostats on every story containing conditioned space - Note that Appendix J will change (See the front piece to Chapter 13 which is repeated as the front piece of Appendix J).

DESCRIPTION OF APPENDIX K

Appendix K , "Floor Protector Thermal Conductivity Calculations" is unique to Massachusetts and supplements the solid fuel-burning section of Chapter 36, Section 3610.

DESCRIPTION OF APPENDIX L

Appendix L, "Schedule of Fees" is unique to Massachusetts and defines initial and renewal licensing fees, initial and renewal Home Improvement Contractor registration fees and associated Guaranty Fund fees, Appeals Board fees, building permit fees, and existing building, periodic inspection fees.

PART III - CROSS REFERENCE BY ARTICLE/CHAPTER

CAUTION

This cross-index is meant as a transition tool for users of the *Sixth Edition* of the Massachusetts State Building Code. It is not meant as an authoritative source for all changes either from the BOCA National Building Code or the *Fifth Edition* of the Massachusetts State Building Code. Always refer to the actual code documents for definitive requirements.

The Table in Part III has been developed for those who are accustomed to using the *Fifth Edition* and previous editions of the Massachusetts State Building Code. The first column lists article and primary section numbers in the *Fifth Edition*; the second column gives the article and section number in the *Sixth Edition*.The balance of the articles in the *Fourth Edition* have an equivalent article in the *Fifth Edition*.

Fifth Edition **Table of Contents**	*Sixth Edition* **Article/Chapter Cross Reference**
Article 1 - ADMINISTRATION AND ENFORCEMENT	**Chapter 1 - ADMINISTRATION** *(Substantial portions of chapter are entirely unique to Massachusetts)*
100.0 Scope	101.0 Scope
101.0 Applicability	102.0 Applicability
102.0 Ordinary repairs	110.3 Exemptions (Application for permit)
103.0 Installation of service repairs equipment	110.0 Permit Application
104.0 Maintenance	103.0 Maintenance
105.0 Change in existing use	102.5 Applicability to existing buildings 110.1 Permit application
106.0 Alterations and repairs	102.5 Applicablity to existing buildings 110.1 Permit application
107.0 Building department	105.0 Office of the inspector of buildings or building commissioner
108.0 Duties and powers of the building official and state inspector	106.0 Duties and powers of the building official 107.0 Duties and powers of the state inspector
109.0 Rules and regulations	108.0 Rules and regulations
110.0 Approval	109.0 Approval
111.0 Inspection	115.0 Inspection
112.0 Right of entry	115.6 General (Inspection)
113.0 Application for permit	110.0 Application for permit
114.0 Permits	111.0 Permits
115.0 Conditions of permit	113.0 Conditions of permit
116.0 Demolition of structures	112.0 Demolition of structures
117.0 Moved structures	102.56 Moved Structures
118.0 Fees	114.0 Fees
119.0 Certificate of use and occupancy	120.0 Certificate of occupancy
120.0 Posting structures	120.5 Posting structures
121.0 Violations	118.0 Violations
122.0 Stop-work order	119.0 Stop-work order
123.0 Unsafe structures	121.0 Unsafe structures
124.0 Emergency measures	121.0 Unsafe structures
125.0 Reserved	
126.0 Board of Appeals	122.0 Board of Appeals
127.0 Construction Control	116.0 Registered architectural and professional engineering services-Construction Control
128.0 Construction Materials Safety Board	123.0 Construction Materials Safety Board
129.0 Activities requiring licenses	108.0 Rules and regulations

Fifth Edition **Table of Contents**	*Sixth Edition* **Article/Chapter Cross Reference**
130.0 Fire-Prevention-Fire Protection Board	124.0 Fire-Prevention-Fire Protection Advisory Committee
131.0 Structural Peer Review Advisory Board	125.0 Structural Peer Review Advisory Committee
140.0 Validity	104.0 Validity 117.0 Workmanship
Article 2 - DEFINITIONS AND CLASSIFICATIONS	**Chapter 2 - DEFINITIONS** (*Additional definitions are provided in appropriate chapters*)
200.0 General	201.0 General
201.0 General definitions	202.0 General definitions
Article 3 - USE GROUP CLASSIFICATION	**Chapter 3 - USE OR OCCUPANCY**
300.0 General	301.0 General
301.0 Classification	302.0 Classification
302.0 Use group A, assembly uses	303.0 Assembly use groups
303.0 Use group B, business uses	304.0 Business use groups
304.0 Use group E, educational uses	305.0 Educational use groups
305.0 Use group F, factory and industrial use	306.0 Factory and industrial use groups
306.0 Use group H, high hazard uses	307.0 High hazard use groups
307.0 Use group I, institutional uses	308.0 Institutional use groups
308.0 Use group M, mercantile uses	309.0 Mercantile use groups
309.0 Use group R, residential uses	310.0 Residential use groups
310.0 Use group S, storage uses	311.0 Storage use groups
311.0 Use group U, Utility and miscellaneous uses	312.0 Utility and miscellaneous use groups
312.0 Doubtful use classification	302.0 Classification
313.0 Mixed use and occupancy	313.0 Mixed use groups
Article 4 - TYPE OF CONSTRUCTION CLASSIFICATION	**Chapter 6 - TYPES OF CONSTRUCTION**
400.0 General	601.0 General
401.0 Construction classification	602.0 Construction classification
402.0 Type 1 construction	603.0 Type 1 construction
403.0 Type 2 construction	603.0 Type 2 construction
404.0 Type 3 construction	604.0 Type 3 construction
405.0 Type 4 construction	605.0 Type 4 construction
406.0 Type 5 construction	606.0 Type 5 construction
Article 5 - GENERAL BUILDING LIMITATIONS	**Chapter 5 - GENERAL BUILDING LIMITATIONS**
500.0 General	501.0 General 502.0 Definitions
501.0 General area and height limitations	503.0 General area and height limitations
502.0 Area modifications	506.0 Area modifications
503.0 Height modifications	504.0 Height modifications
504.0 Unlimited areas	507.0 Unlimited areas
505.0 Existing buildings	505.0 Mezzanines
506.0 Street encroachments	3202.0 Street encroachments
507.0 Permissible street projections	3203.0 Permissible street encroachments
508.0 Permissible yard and court encroachments	3202.0 Street encroachments
509.0 Special and temporary projections	3204.0 Special and temporary projections
510.0 Awnings and canopies	3205.0 Awnings and canopies
511.0 Temporary structures	3104.0 Temporary structures
512.0 Physically handicapped and aged	Chapter 11

Fifth Edition Table of Contents	*Sixth Edition* Article/Chapter Cross Reference
513.0 Special historic buildings and districts	3409.0 Historic buildings
Article 6 - SPECIAL USE AND OCCUPANCY REQUIREMENTS	**Chapter 4 - SPECIAL USE AND OCCUPANCY**
600.0 General	401.0 General
601.0 Covered mall buildings	402.0 Covered mall buildings
602.0 High-rise buildings	403.0 High rise buildings
603.0 HPM use facilities	416.0 HPM facilities
604.0 Membrane structures	3103.0 Membrane structures
605.0 Mezzanines	505.0 Mezzanines
606.0 Open wells	404.0 Atriums
607.0 Open parking garages	406.0 Open parking garage
608.0 Private garages	407.0 Private garages
609.0 Public garages	408.0 Public garages
610.0 Use group I-2	409.0 Use group I-2
611.0 Use group I-3	410.0 Use group I-3
612.0 Bleachers, grandstands and folding or telescopic seating	1013.0 Grandstands
613.0 Motion picture projections rooms, screening rooms and sound stages	411.0 Motion picture projections rooms, screening rooms and sound stages
614.0 Rooftop heliports	1511.0 Rooftop heliports
615.0 Stages and Platforms	412.0 Stages and platforms
616.0 Airport traffic control towers	414.0 Airport traffic control towers
617.0 Combustible dust, gain processing and storage	307.4 Use group H-2 structures/ 418.0
618.0 Explosion hazards	307.3 Use group H-1 structures/ 418.0
619.0 Flammable and combustion liquids	307.4 Use group H-2 structures/ 418.0
620.0 Liquefied petroleum gas facilities	307.4 Use group H-2 structures/ 418.0
621.0 Mobile unit	420.0 Mobile unit
622.0 Paint spraying and spray booths	
623.0 Radio and television towers	3108.0 Radio television towers
624.0 Radio and television antennae	3109.0 Radio television antennas
625.0 Swimming pools	421.0 Swimming pools
626.0 Temporary structures	3104.0 Temporary structures
627.0 Fire prevention codes	Appendix A
628.0 Special permits and certificates of fitness	111.0 Permits 3204.0 Special and temporary projections
629.0 Existing buildings	422.0 Existing buildings/ Chapter 34
630.0 Amusement parks	413.0 Special amusement buildings
631.0 Group residence	423.0 Group residence
632.0 Nursing homes...etc.	409.0 Use group I-2
633.0 Child day care centers	424.0 Day Care Centers
634.0 Summer camps for children	425.0 Summer Camps for Children
635.0 Historic buildings	3409.0 Historic buildings
636.0 Limited group residences	427.0 Limited group residences
637.0 Detoxification Facilities	428.0 Detoxification Facilities
638.0 Group dwelling units	429.0 Group dwelling
-	405.0 Underground structures
-	426.0 Bulk merchandising retail buildings

Fifth Edition Table of Contents	*Sixth Edition* Article/Chapter Cross Reference
Article 7 - INTERIOR ENVIRONMENTAL REQUIREMENTS	**Chapter 12- INTERIOR ENVIRONMENT**
700.0 General	1201.0 General 1202.0 Definitions
701.0 Plans and specifications	1203.0 Construction documents
702.0 Existing building	3400.6 Unsafe lighting and/ or unsafe ventilation
703.0 Light and ventilation required	1205.0 Light and ventilation required
704.0 Natural light	1206.0 Natural light
705.0 Artificial light	1207.0 Artificial light
706.0 Natural ventilation	1208.0 Natural ventilation
707.0 Mechanical ventilation	1209.0 Mechanical ventilation
708.0 Room dimensions	1204.0 Room dimensions
709.0 Ventilation of special spaces	1210.0 Ventilation of special spaces
	1211.0 Access to crawl spaces and attics
710.0 Courts	1212.0 Courts and yards
711.0 Rear yards	1212.0 Courts and yards
712.0 Obstruction of courts and yards	1213.0 Obstruction of courts and yards
713.0 Window cleaning safeguards	3110.0 Window -cleaning safeguards
714.0 Sound transmission control in residential buildings	1214.0 Sound transmission control in residential buildings
Article 8 - MEANS OF EGRESS	**Chapter 10 - MEANS OF EGRESS**
800.0 General	1001.0 General
801.0 Plans and specifications	1002.0 Definitions 1003.0 Construction documents
802.0 Use and occupancy requirements	1004.0 Use group and occupancy requirements
803.0 Prohibited use	
804.0 Existing buildings	3400.4 Special provisions for means of egress
805.0 Maintenance of exits	1028.0 Maintenance of exits
806.0 Occupant load	1008.0 Occupant load
807.0 Types and location of means of egress	1006.0 Types and location of means of egress
808.0 Capacity of egress components	1009.0 Capacity of egress components
809.0 Number of exits	1010.0 Number of exits
810.0 Exit access passageways and corridors	1011.0 Exit access passageways and corridors
811.0 Level of exit discharge passageways used as an exit element	1020.0 Level of exit discharge passageways used as an exit element
812.0 Means of egress doorways	1017.0 Means of egress doorways
813.0 Revolving doors	1018.0 Revolving doors
814.0 Horizontal exits	1019.0 Horizontal exits
815.0 Ramps	1016.0 Ramps
816.0 Interior stairways	1014.0 Stairways
817.0 Access to roof	1027.0 Access to roofs
818.0 Smokeproof enclosures	1015.0 Smokeproof enclosures
819.0 Exterior stairways	1014.0 Stairways
820.0 Escalators and moving walks	Chapter 30
821.0 Fire escapes	1025.0 Fire escapes
822.0 Slidescapes	1026.0 Slidescapes
823.0 Exit signs and lights	1023.0 Exit signs and lights
824.0 Means of egress lighting	1024.0 Means of egress lighting
825.0 Hazards to means of egress	1005.0 General limitations
826.0 Assembly aisles	1012.0 Assembly aisles and aisles accessways

Fifth Edition Table of Contents	*Sixth Edition* Article/Chapter Cross Reference
827.0 Guards	1021.0 Guards
828.0 Handrails	1022.0 Handrails
Article 9 - FIRERESISTIVE CONSTRUCTION	**Chapter 7 - FIRERESISTANT MATERIALS AND CONSTRUCTION**
900.0 General	701.0 General
	702.0 Definitions
901.0 Plans and specifications	703.0 Construction documents
902.0 Fire hazard classification	Table 313.1.2 Fireresistant ratings for fire separation
903.0 Fire tests	704.0 Fire tests
904.0 Flame spread and flame resistance tests	Chapter 8 Interior Finishes
905.0 Special fireresistive requirement	Chapter 8 Interior Finishes
906.0 Exterior walls	705.0 Exterior walls
907.0 Exterior opening protectives	706.0 Exterior opening protectives
908.0 Fire walls and party walls	707.0 Fire walls and party walls
909.0 Fire wall openings	708.0 Fire wall openings
910.0 Fire separation walls	709.0 Fire separation assemblies
911.0 Smoke barriers	712.0 Smoke barriers
912.0 Fireresistance rating of structural members	715.0 Fireresistance rating of structural members
913.0 Fireresistance rated floor/roof/ceiling assemblies	713.0 Floor/ceiling and roof/ceiling assemblies
914.0 Roof construction	714.0 Roof construction
915.0 Vertical shafts	710.0 Vertical shafts
916.0 Fire door assemblies	716.0 Fire door assemblies
917.0 Fire windows and shutters	718.0 Fire windows and shutters
918.0 Fire dampers	717.0 Fire dampers
919.0 Wired glass	719.0 Wired glass
920.0 Fireresistive requirements for plaster	721.0 Fireresistive requirements for plaster
921.0 Firestopping and draftstopping	720.0 Firestopping and draftstopping
922.0 Interior finish and trim	803.0 Interior finish and trim
923.0 Application of interior finish	804.0 Application of interior finish
924.0 Combustible materials permitted in floors on Type 1 and 2 construction	806.0 Combustible materials permitted in floors on Type 1 and 2 construction
925.0 Decorative material restrictions	807.0 Interior hanging and decorations
926.0 Exterior trim restrictions	705.1.2 Combustible, exterior wall finish and trim
927.0 Roof structures	714.0 Roof construction
928.0 Thermal and sound insulating materials	722.0 Thermal - and sound-insulating materials
929.0 Plenums	2805.0 Plenums
930.0 Smoke and heat vents	921.0 Smoke control systems 922.0 Smoke and heat vents
Article 10 - FIRE PROTECTION SYSTEMS	**Chapter 9- FIRE PROTECTION SYSTEMS**
1000.0 General	901.0 General
1001.0 Plans and specifications	903.1.1 Fire protection construction documents
1002.0 Fire suppression systems	904.0 Fire suppression systems
1003.0 Suppression system selection	905.0 Suppression system agent compatibility
1004.0 Water sprinkler systems	906.0 Fire sprinkler systems
1005.0 Limited area sprinkler systems	907.0 Limited area sprinkler systems
1005.0 Water-spray fixed systems	908.0 Water-spray sprinkler systems
1007.0 Foam extinguishing systems	911.0 Foam extinguishing systems
1008.0 Carbon dioxide extinguishing systems	909.0 Carbon dioxide extinguishing systems

Fifth Edition **Table of Contents**	*Sixth Edition* **Article/Chapter Cross Reference**
1009.0 Halogenated fire extinguishing systems	912.0 Halogenated extinguishing systems
1010.0 Dry chemical extinguishing systems	910.0 Dry-chemical extinguishing systems
1011.0 Wet chemical range hood extinguishing systems	913.0 Wet-chemical range hood extinguishing systems
1012.0 Standpipe systems	914.0 Standpipe systems
1013.0 Standpipe systems for buildings under construction or demolition	3305.0 Fire hazards
1014.0 Fire department connections	915.0 Fire department connections
1015.0 Water supply and other extinguishing media	903.0 Fire protection systems approval/ acceptance
1016.0 Yard hydrants	916.0 Yard hydrants/Underground fire mains
1017.0 Fire protection signaling systems	917.0 Fire protection signaling systems
1018.0 Automatic fire detection systems	918.0 Automatic fire detection systems
1019.0 Smoke control systems	921.0 Smoke control systems
1020.0 Supervision	923.0 Supervision
1021.0 Fire Extinguishers	920.0 Fire Extinguishers
Article 11 - STRUCTURAL LOADS	**Chapter 16 - STRUCTURAL LOADS** *(Portions of this chapter are entirely unique to Massachusetts)*
1100.0 General	1601.0 General 1602.0 Definitions
1101.0 Plans and Specifications	1603.0 Construction documents
1102.0 Design safe load	1604.0 Design safe load
1103.0 Design live load	1607.0 Design live load
1104.0 Design dead load	1605.0 Design dead load
1105.0 Existing buildings	1617.0 Existing buildings
1106.0 Uniformly distributed live loads	1606.0 Uniformly distributed live loads
1107.0 Concentrated loads	1613.0 Concentrated loads
1108.0 Impact loads	1614.0 Impact loads
1109.0 Special loads	1615.0 Special loads
1110.0 Special consideration for roofs	1609.0 Roof loads
1111.0 Snow loads	1610.0 Snow loads
1112.0 Wind loads	1611.0 Wind loads
1113.0 Earthquake loads	1612.0 Earthquake loads
1114.0 Combination of loads	1616.0 Combination of loads
1115.0 Live load reduction	1608.0 Live load reduction
Article 12 - FOUNDATION SYSTEMS AND RETAINING WALLS	**Chapter 18 - FOUNDATIONS AND RETAINING WALLS** *(Portions of this chapter are entirely unique to Massachusetts)*
1200.0 General	1801.0 General
1201.0 Bearing pressures on foundation materials	1804.0 Load bearing value of soils
1202.0 Subsurface explorations	1802.0 Foundation investigations
1203.0 Soil bearing tests	1803.0 Soil bearing tests
1204.0 Allowable foundation loads	1805.0 Allowable foundation loads
1205.0 Depth of footings	1806.0 Depth of footings
1206.0 Footing design	1807.0 Footing design
1207.0 Timber footings and wood foundations	1808.0 Timber footings and wood foundations
1208.0 Steel grillages	1809.0 Steel grillages
1209.0 Concrete footings	1810.0 Concrete footings
1210.0 Masonry unit footings	1811.0 Masonry unit footings

Fifth Edition **Table of Contents**	*Sixth Edition* **Article/Chapter Cross Reference**
1211.0 Mat, raft and float foundations	1814.0 Mat, raft and float foundations
1212.0 Pier foundations	1815.0 Pier foundations
1213.0 Pile foundations	1816.0 Pile foundations
1214.0 Allowable pile loads	1817.0 Allowable pile loads
1215.0 Structural steel piles	1818.0 Structural steel piles
1216.0 Concrete-filled steel pipe and tapered tubular piles	1819.0 Concrete-filled steel pipe and tapered tube piles
1217.0 Cast-in-place concrete piles	1820.0 Cast-in-place concrete piles
1218.0 Precast concrete piles	1821.0 Precast concrete piles
1219.0 Timber piles	1822.0 Timber piles
1220.0 Composite piles	1823.0 Composite piles
1221.0 Concrete-filled pipe with steel core caissons	1824.0 Concrete-filled pipe with steel core caissons
1222.0 Foundation walls	1812.0 Foundation walls
1223.0 Retaining walls	1825.0 Retaining walls
1224.0 Waterproofing and dampproofing	1813.0 Waterproofing and dampproofing
Article 13 - MATERIALS AND TESTS	**Chapter 17 - STRUCTURAL TESTS AND INSPECTIONS**
1300.0 General	1701.0 General 1702.0 Definitions
1301.0 Alternative test procedure	1707.0 Alternative test procedure
1302.0 Test safe load	1708.0 Test safe load
1303.0 Tests	1703.0 Information required 1704.0 Approvals
1304.0 Design strengths of materials	1706.0 Design strengths of materials
1305.0 Conditions of acceptance	1703.0 Information required 1704.0 Approvals
1306.0 Approvals	1704.0 Approvals
Article 14 - MASONRY	**Chapter 21 - MASONRY**
1400.0 General	2101.0 General
1401.0 Masonry construction units	2105.0 Masonry construction materials
1402.0 Brick units	2105.2 Clay or shale masonry units
1403.0 Structural clay tile units	2105.2 Clay or shale masonry units
1404.0 Glazed clay masonry units	2105.2 Clay or shale masonry units
1405.0 Concrete units	2105.2 Clay or shale masonry units
1406.0 Architectural terra cotta	2105.2 Clay or shale masonry units
1407.0 Natural stone	2105.3 Stone masonry units
1408.0 Cast stone	2105.3 Stone masonry units
1409.0 Mortar and grout for masonry	2105.7 Mortar
1410.0 Masonry wall construction	Chapter 21 - 2112.0 Masonry construction
1411.0 Bonding of walls	2110.0 Bond
1412.0 Lateral bracing of walls	2106.0 Lateral stability/2108.0 Lateral support
1413.0 Chases and recesses in bearing walls	Chapter 21 - 2112.1.4 Chases
1414.0 Waterproofing chases	2112.0 Masonry construction
1415.0 Corbeled and projected masonry	2112.2 Corbeled masonry
1416.0 Bearing on hollow unit walls	2112.0 Masonry construction
1417.0 Engineered unreinforced masonry	2101.1.1 Engineered masonry design
1418.0 Reinforced masonry	Chapter 21: 2101.1.1; 2104.0 and 2112.0
1419.0 Unreinforced Masonry	2112.0 Masonry construction
1420.0 Structural glass block units	2115.0 Glass block walls

Fifth Edition **Table of Contents**	*Sixth Edition* **Article/Chapter Cross Reference**
1421.0 Isolated piers	Chapter 21
1422.0 Dry - stacked, surface-boarded masonry walls	Chapter 21
Article 15 - CONCRETE	Chapter 19 - CONCRETE
1500.0 Concrete design standards	1901.0 Concrete design standards
1501.0 Seismic design provisions	1902.0 Definitions 1903.0 Seismic requirements for reinforce concrete
1502.0 Materials	1904.0 Seismic requirements for plain concrete 1906.0 Materials 1907.0 Durability
1503.0 Concrete quality	1908.0 Concrete quality, mixing and placing
1504.0 Mixing and placing of concrete	1908.0 Concrete quality, mixing and placing
1505.0 Formwork, embedded pipes, and construction joints	1909.0 Formwork, embedded pipes, and construction joints
1506.0 Details of reinforcement	1910.0 Details of reinforcement
1507.0 Concrete-filled pipe columns	1912.0 Concrete-filled pipe columns
1508.0 Shotcrete	1911.0 Shotcrete
1509.0 Minimum slab thickness	1905.0 Minimum slab thickness
Article 16 - GYPSUM AND PLASTER	**Chapter 25 - GYPSUM BOARD AND PLASTER**
1600.0 General	2501.0 General 2502.0 Shear walls
1601.0 Interior lathing and gypsum plastering	2505.0 Intrerior lathing and gypsum plastering
1602.0 Portland cement stucco lath and plaster	2506.0 Portland cement stucco lath and plaster
1603.0 Gypsum board materials	2503.0 Gypsum board materials
1604.0 Gypsum construction	2504.0 Gypsum construction
Article 17 - WOOD	**Chapter 23 - WOOD**
1700.0 General	2301.0 General
1701.0 Lumber and timber construction	Chapter 23
1702.0 Heavy timber type construction	2304.0 Heavy timber construction
1703.0 Design and construction	Chapter 23
1704.0 Wall construction	Chapter 23
1705.0 Floor construction	Chapter 23
1706.0 Roof construction	Chapter 23
1707.0 Stress skin panels	Chapter 23
1708.0 Structural glued-laminated timber and built-up wood construction	Chapter 23
1709.0 Fiber boards	2309.0 Fiber boards
1710.0 Plywood	Chapter 23
1711.0 Particle board	2308.0 Particle board
1712.0 Protection against decay and termites	Chapter 23
Article 18 - STEEL	**Chapter 22 - STEEL**
1800.0 General	2201.0 General 2202.0 Definitions
1801.0 Structural steel construction	2203.0 Structural steel construction
1802.0 Formed steel construction	2204.0 Seismic requirements for structural steel 2206.0 Formed steel construction
1803.0 Open web steel joist construction	2205.0 Open web steel joist construction
1804.0 Reinforcing steel	2208.0 Reinforcing steel
1805.0 Cast steel construction	2209.0 Cast steel construction

Fifth Edition Table of Contents	*Sixth Edition* Article/Chapter Cross Reference
1806.0 Cast iron construction	2210.0 Cast iron construction
1807.0 Special steel and steel cable structural systems	2207.0 Special steel and steel cable structural systems
1808.0 Exterior steel frame corrosion protection under masonry	2211.0 Exterior steel frame corrosion protection under masonry
Article 19 - LIGHTWEIGHT METAL ALLOYS	**Chapter 20 - LIGHTWEIGHT METALS**
1900.0 General	2001.0 General
1901.0 Materials	2002.0 Materials
Article 20 - PLASTIC	**Chapter 26 - PLASTIC**
2000.0 General	2601.0 General 2602.0 Definitions
2001.0 Light-transmitting plastics	2604.0 General requirements for light transmitting plastics 2605.0 Light-transmitting wall panels 2606.0 Light-transmitting plastic glazing of unprotected openings 2606.0 Light-transmitting plastic roof panels 2608.0 Light-transmitting skylight glazing
2002.0 Foam plastics	2603.0 Foam plastics
Article 21 - EXTERIOR WALLS	**Chapter 14 - EXTERIOR WALL COVERINGS**
2100.0 General	1401.0 General
2101.0 General construction requirements	1403.0 Performance requirements
2102.0 Flood resistant construction	3107.0 Flood-resistant construction
2103.0 Ratproofing	1403.7 Ratproofing and Chapter 12
2104.0 Weather protection	1403.3 Weather resistance
2105.0 Wall panels	1405.0 Veneers
2106.0 Metal veneers	1405.0 Veneers
2107.0 Masonry veneers	1405.0 Veneers
2108.0 Thin stone and tile veneers	1405.0 Veneers
2109.0 Structural glass veneers	1405.0 Veneers
Article 22 - VERTICAL AND SLOPED GLASS GLAZING	**Chapter 24 - GLASS AND GLAZING**
2200.0 General	2401.0 General
2201.0 General requirement for glass	2402.0 General requirement for glass
2202.0 Wind loads for glass	2403.0 Wind, snow and dead loads on glass
2203.0 Safety glazing	2405.0 Safety glazing
2204.0 Sloped glazing and skylights	2404.0 Sloped glazing and skylights
2205.0 Light-transmitting plastic glazing of unprotected openings	2604.0 General requirements for light transmitting plastics
2206.0 Light in handrails and guardrails	2406.0 Glass in handrails and guardrails
2207.0 Glazing in racquetball and squash courts	2407.0 Glazing in racquetball and squash courts
Article 23 - ROOFS AND ROOF COVERINGS	**Chapter 15 - ROOFS AND ROOF COVERINGS**
2300.0 General	1501.0 General 1502.0 Definitions
2301.0 Fire classification	1506.[illegible] Fire classification
2302.0 Wood shingles	1505.0 Performance requirements 1507.2.8 Wood shingles
2303.0 Asphalt shingles	1505.0 Performance requirements 1507.2.3 Asphalt shingles

Fifth Edition Table of Contents	*Sixth Edition* Article/Chapter Cross Reference
2304.0 Flashing	1508.0 Flashing
2305.0 Fastening	1505.0 Performance requirements 1507.0 Prescriptive requirements
2306.0 Light-transmitting plastic roof panels	2604.0 General requirements for light transmitting plastics
-	1503.0 Construction documents
-	1504.0 Weather Protection
-	1509.0 Roof insulation
-	1510.0 Roof structures
-	1511.0 Rooftop heliports
-	1512.0 Reroofing
Article 24 - MASONRY FIREPLACES	**2114.0 FIREPLACES AND CHIMNEYS**
2400.0 General	2114.1 Scope
2401.0 Plans and specifications	2103.0 Construction documents
2402.0 Construction requirements	2114.0 Fireplaces and chimneys
Article 25 - MECHANICAL EQUIPMENT AND SYSTEMS	**Chapter 28 - MECHANICAL SYSTEMS**
2500.0 General	2801.0 General
2501.0 Plans, specifications and permits	2802.0 Construction documents
2502.0 Inspections and tests	2804.0 Inspections and tests
2503.0 Existing buildings	2802.0 Construction documents 2811.0 Existing buildings
2504.0 Fees	2803.0 Fees
2505.0 Drying rooms	2806.0 Drying rooms
2506.0 Waste and linen handling systems	2807.0 Waste and linen handling systems
2507.0 Refuse vaults	2808.0 Refuse vaults
2508.0 Dust, stock and refuse conveyor systems	2808.0 Refuse vaults
2509.0 Medical gases	2809.0 Medical gases
2510.0 Oxygen systems	2810.0 Oxygen systems
2511.0 Boiler rooms	302.1.1 Specific occupancy areas
2512.0 Solid fuel burning heating appliances	2813.0 Solid fuel burning heating appliances
	2805.0 Plenums
	2812.0 Power vents
Article 26 - ELEVATOR, DUMBWAITER AND CONVEYOR EQUIPMENT, INSTALLATION AND MAINTENANCE	**Chapter 30 - ELEVATOR AND CONVEYOR SYSTEMS** *(This chapter is entirely unique to Massachusetts See Chapter 30 for information regarding 524 CMR)*
2600.0 General	
2601.0 Plans, specifications and permits	
2602.0 Tests and inspections	
2603.0 Certificate of compliance	
2604.0 Maintenance and accidents	
2605.0 Existing installations	
2606.0 Alterations	
2608.0 Hoistway enclosures and venting	
2609.0 Elevator and dumbwaiter machinery and equipment	
2610.0 Machine rooms and related construction for passenger and freight elevators and dumbwaiters	

Fifth Edition **Table of Contents**	*Sixth Edition* **Article/Chapter Cross Reference**
2611.0 Elevator opening protectives	
2612.0 Elevator car emergency signals and signs	
2613.0 Manlifts (prohibited)	
2614.0 Industrial lifts and loading ramps	
2615.0 Automotive lifts	
2616.0 Conveyors	
2617.0 Escalators	
Article 27 - ELECTRICAL WIRING AND EQUIPMENT	**Chapter 27 - ELECTRICAL WIRING, EQUIPMENT, AND SYSTEMS** *(This chapter is entirely unique to Massachusetts)*
Article 28 - PLUMBING AND GAS FITTING	**Chapter 29 - PLUMBING SYSTEMS** *(This chapter is entirely unique to Massachusetts)*
Article 29 - SIGNS	**CHAPTER 31 -SPECIAL CONSTRUCTION**
2900.0 General	3102.1 General
2901.0 Plans, specifications and permits	3102.4 Permits and construction documents
2902.0 Exemptions	3102.4.3 Permit exemptions
2903.0 Unsafe and unlawful signs	3102.5.1 Removal
2904.0 Existing signs	3102.4.2 Alterations
2905.0 Maintenance and inspection	3102.5 Maintenance and Inspections
2906.0 Bonds and liability insurance	3102.0 Signs
2907.0 General requirements for all signs	3102.0 Signs
2908.0 Ground signs	3102.7 Ground signs
2909.0 Roof signs	3102.8 Roof signs
2910.0 Wall signs	3102.9 Wall signs
2911.0 Projecting signs	3102.10 Projecting signs
2912.0 Marquee signs	3102.11 Marquee signs
2913.0 Miscellaneous and temporary signs	3102.12 Temporary signs
2914.0 Illuminated signs	3102.13 Illuminated signs
2915.0 Portable signs	3102.14 Portable signs
Article 30 - PRECAUTIONS DURING BUILDING OPERATIONS	**Chapter 33 - SITE WORK, DEMOLITION AND CONSTRUCTION**
3000.0 General	3301.0 General
3001.0 Plans, specification and special permits	3302.0 Construction documents and special permits
3002.0 Tests	3303.0 Tests
3003.0 Inspection	3301.0 General
3004.0 Maintenance	3306.0 Maintenance
3005.0 Existing buildings	3309.0 Existing buildings
3006.0 Protection of public and workmen	3304.0 Protection of public
3007.0 Demolition and excavation	3310.0 Demolition and excavation
3008.0 Regulations of lots	
3009.0 Retaining walls and partition fences	3311.0 Retaining walls and partition fences
3010.0 Storage of materials	3312.0 Storage of materials and construction equipment
3011.0 Removal of waste material	3313.0 Removal of waste material
3012.0 Protection of adjoining property	3308.0 Protection of adjoining property
3013.0 Protection of floor and wall openings	3304.0 Protection of public
3014.0 Scaffolds	3312.0 Storage of materials and construction equipment
3015.0 Hoists	3312.0 Storage of materials and construction equipment

Fifth Edition **Table of Contents**	*Sixth Edition* **Article/Chapter Cross Reference**
3016.0 Stairways and ladders	3314.0 Stairways
3017.0 Lighting	3315.0 Lighting
3018.0 Fire hazards	3305.0 Fire hazards
3019.0 Health hazards	3307.0 Health hazards
3020.0 Welding safety precautions	3304.0 Protection of materials and construction equipment
3021.0 Sanitation	
3022.0 Disputes	
Article 31 - ENERGY CONSERVATION	**Chapter 13 - ENERGY CONSERVATION** *(This chapter is entirely unique to Massachusetts)*
3100.0 General	1301.0 General
3101.0 Administrative	1301.1 Administrative
3102.0 Existing buildings	1302.0 Existing buildings
3103.0 Plans and specifications	1303.0 Plans and specifications
3104.0 Materials and equipment	1304.0 Materials and equipment
3105.0 Design conditions	1305.0 Design conditions
3106.0 Building insulation specifications	1306.0 Building insulation specifications
3107.0 Air infiltration & moisture control	1307.0 Air infiltration & moisture control
3108.0 Component design	1308.0 Component design
3109.0 Exterior envelope requirements for low-rise residential buildings	1309.0 Exterior envelope requirements for low-rise residential buildings
3110.0 Heating, ventilating, & air-conditioning (HVAC) systems	1310.0 Heating, ventilating, & air-conditioning (HVAC) systems
3111.0 Heating, ventilating & air-conditioning equipment	1311.0 Heating, ventilating & air-conditioning equipment
3112.0 Electric power distribution	1312.0 Electric power distribution
3013.0 Lighting systems	1313.0 Lighting systems
3014.0 Building envelope requirements for commercial and high-rise residential buildings	1314.0 Building envelope requirements for commercial and high-rise residential buildings
3115.0 Building design by system analysis	1315.0 Building design by system analysis
3116.0 Buildings utilizing solar, geothermal, wind or other non-depleatable energy sources as alternative design	1316.0 Buildings utilizing solar, geothermal, wind or other non-depletable energy sources as alternative design
Article 32 - REPAIR, ALTERATION, ADDITION AND CHANGE OF USE OF EXISTING BUILDINGS	**Chapter 34 - REPAIR, ALTERATION, ADDITION AND CHANGE OF USE OF EXISTING BUILDINGS** *(This chapter is entirely unique to Massachusetts)*
3200.0 Scope	3400.1 Scope
3201.0 Definitions	3401.0 Definitions
3202.0 Implementation	3402.0 Implementation
3203.0 Requirements for continuation of the same use group of equal or lesser hazard index	3404.0 Requirements for continuation of the same use group or change to a use group resulting in a change in hazard index of one or less
3204.0 Requirements for change in use group to one hazard index greater	3404.0 Requirements for continuation of the same use group or change to a use group resulting in a change in hazard index of one or less
3205.0 Requirements for change in use group to two or more hazard indices greater	3405.0 Requirement for change in use group to two of more hazard indices greater
3206.0 Compliance alternatives	3406.0 Compliance alternatives
3207.0 Energy provisions for existing buildings	3407.0 Energy provisions for existing buildings

Fifth Edition **Table of Contents**	*Sixth Edition* **Article/Chapter Cross Reference**
3208.0 Other code sections pertaining to repair, alteration, or change of use of existing buildings	3408.0 Structural requirements for existing buildings
Article 33 - MANUFACTURED BUILDINGS, BUILDING COMPONENTS AND MOBILE HOMES	**Chapter 35 - MANUFACTURED BUILDINGS, MANUFACTURED BUILDING COMPONENTS, AND MANUFACTURED HOUSING** *(This chapter is entirely unique to Massachusetts)*
3300.0 General	3501.0 General 3502.0 Definitions
3301.0 Approval	3503.0 Construction documents 3504.0 Approval
3302.0 Certification	3505.0 Certification
3303.0 Reciprocity	3506.0 Reciprocity
3304.0 Assurance inspection	3507.0 Assurance inspection
3305.0 Responsibility of the building official	3508.0 Responsibility of the local enforcement agencies
3306.0 Suspension and revocation of certification	3509.0 Suspension and revocation of certification
Article 34 - ONE AND TWO FAMILY DWELLINGS	**Chapter 36 - ONE AND TWO FAMILY DWELLINGS** *(Portions of this chapter are entirely unique to Massachusetts)*
3400.0 General	3601.1 General administration
3401.0 Building Planning	3603.0 Building Planning
3402.0 Foundations	3604.0 Foundations
3403.0 Wall Construction	3606.0 Wall Construction
3404.0 Wall Covering	3607.0 Wall Covering
3405.0 Floors	3605.0 Floors
3406.0 Roof-ceiling construction	3608.0 Roof-ceiling construction
3407.0 Roof coverings	3609.0 Roof coverings
3408.0 Chimneys, fireplaces and connector plates	3610.0 Chimneys and fireplaces
3409.0 Solid fuel burning appliances	3610.0 Chimneys and fireplaces
3410.0 Mechanical equipment, general	Sections 3611, 3612 and 3613
3411.0 Combustion air	3620.0 Combustion air
3412.0 Warm-air furnace	3614.0 Heating and cooling equipment
3413.0 Vented decorative appliances, floor furnaces, vented wall furnaces and vented room heaters	3616.0 Vented floor, wall and room heaters
3414.0 Venting of appliances	3616.0 Vented floor, wall and room heaters
3415.0 Ducts	3619.0 Duct systems
3416.0 Comfort cooling	3614.0 Heating and cooling equipment
3417.0 Absorption units and absorption systems for comfort cooling and comfort heating	3614.0 Heating and cooling equipment
3418.0 Fuel supply systems	3614.0 Heating and cooling equipment
3419.0 Energy conservation by component design	3603.21 Energy conservation requirements
3420.0 Building insulation	3603.19 Insulation/flame spread, smoke developed/critical radiant flux, and; 3603.21 Energy conservation requirements
3421.0 Ventilation	3617.0 Ventilation air supply
3422.0 Vapor barriers	3603.21 Energy conservation requirements
3423.0 U-values of building components	3603.21 Energy conservation requirements
3424.0 Air leakage for all buildings	3603.21 Energy conservation requirements

Fifth Edition **Table of Contents**	*Sixth Edition* **Article/Chapter Cross Reference**
3425.0 System design heating/cooling capacity	3614.0 Heating and cooling equipment/3603.21
3426.0 Controls	3603.21 Energy conservation requirements
3427.0 Balancing	3603.21 Energy conservation requirements
3428.0 Duct insulation	3619.0 Duct systems/3603.21 Energy conservation requirements
3429.0 Pipe insulation	3603.21 Energy conservation requirements
Reference Standards	Appendix A
Index to Tables and Figures	
General Index	General Index
APPENDICES	APPENDICES
A Reference Standards	A Reference Standards
B Unit dead loads for design purposes	G Unit dead loads for design purposes
C Recommended fastening schedule	C Recommended fastening schedule
D Guidance for selection of foundation material classes in table 1804.3	D Guidance for selection of foundation material classes in table 1804.3
E Procedure for accounting for series and parallel heat flow paths	E Procedure for accounting for series and parallel heat flow paths
F Reference data for repair, addition, and change of use of existing buildings	F Reference data for repair, addition, and change of use of existing buildings
G Specialized Massachusetts rules and regulations other than state building code commission	A Appendix A
H Historic structures	H Historic structures
-	B Sample building permit application forms state building code appeals application forms official interpretations
-	J Energy conservation for low-rise residential building
-	K Floor protector thermal conductivity calculations
	L Schedule of Fees
SPECIAL REGULATIONS	SPECIAL REGULATIONS
780 CMR-1 Concrete Testing Laboratories Licensing	780 CMR R1 Concrete Testing Laboratories Licensing
780 CMR-2 Concrete Testing Personnel Licensing	780 CMR R2 Concrete Testing Personnel Licensing
780 CMR-3 Manufactured Buildings, Building Components and Manufactured Homes	780 CMR R3 Manufactured Buildings, Building Components and Manufactured Homes
780 CMR-4 Use of Native Lumber	780 CMR R4 Use of Native Lumber
780 CMR-5 Construction Supervisors Licensing	780 CMR R5 Construction Supervisors Licensing
780 CMR-6 Home Improvement Contractor Registration	780 CMR R6 Home Improvement Contractor Registration
780 CMR-7 Certification of Building Code Enforcement Officials	780 CMR R7 Certification of Building Code Enforcement Officials

NON-TEXT PAGE

THE COMMONWEALTH OF MASSACHUSETTS
William Francis Galvin, Secretary of the Commonwealth
State Publications and Regulations

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1. Regulation Chapter, Number & Heading: **780 CMR**
AMENDMENT SEPTEMBER 9, 2005

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STATE BOARD OF BUILDING REGULATIONS & STANDARDS

3. This document is reprinted from the Code of Massachusetts Regulations and contains the following:

780 CMR 1 Administration (Effective 9/9/05)

780 CMR 3 Use or Occupancy (Effective 8/26/05)

780 CMR 9 Fire Protection Systems (Effective 9/9/05)

780 CMR 10 Means of Egress (Effective 8/26/05)

780 CMR 28 Mechanical Systems (Effective 8/26/05)

780 CMR 34 Repair, Alteration, Additon & Change of Use of Existing Structures (Effective 9/9/05)

780 CMR APPENDIX A - Reference Standards (Effective 8/26/05)

780 CMR R6 -Registration and Enforcement of Home Improvement Contractor Program (Effective 9/9/05)

780 CMR R7-Certification of Inspectors of Bulldings, Building Commissions and Local Inspectors (Effective 8/26/05)

Under the Provisions of Massachusetts General Laws, Chapter 30A, § 6, and Chapter 233, § 75, this document may be used as evidence of the original documents on file with the Secretary of the Commonwealth.

Compiled as in full force and effect: **09/09/05**

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A true copy attest:

William Francis Galvin

WILLIAM FRANCIS GALVIN
Secretary of the Commonwealth

9/9/05

IMPORTANT
UPDATES TO YOUR BUIDLING CODE

AMENDMENTS TO THE BUILDING CODE published in Massachusetts Register #1034
9/9/2005

In order to update your Sixth Edition Building Code (dated 4/26/01), please **replace your COVER (top) PAGE, with the attached Regulation Filing and Publication page for 780 CMR Compiled as in full force and EFFECTIVE:** ***9/9/2005.***

Please follow the instructions on the **regulation filing pages (2nd page-bottom section)** for each amended chapter. You are instructed to ***remove certain pages and (replace) insert (NEW) pages*** to update your Building Code. Below are the Chapters that have been amended:

780 CMR 1	ADMINISTRATION – Effective 9/9/05
780 CMR 3	USE OF OCCUPANCY – Effective 8/26/05
780 CMR 9	FIRE PROTECTION SYSTEMS –Effective 9/9/05
780 CMR 10	MEANS OF EGRESS – Effective 8/26/05
780 CMR 28	MECHANICAL SYSTEMS- Effective 8/26/05
780 CMR 34	REPAIR, ALTERATION, ADDITION, AND CHANGE OF USE OF EXISTING STRUCTURES. Effective 9/09/05
780 CMR APPENDIX A	– REFERENCE STANDARDS - Effective 8/26/05
780 CMR R6	REGISTRATION AND ENFORCEMENT OF HOME IMPROVEMENT CONTRACTOR PROGRAM -Effective date 9/9/05
780 CMR R7	CERTIFICATION OF INSPECTORS OF BUILDINGS, BUILDING COMMISSIONERS AND LOCAL INSPECTORS Effective 8/26/05

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780 CMR 1 Administration
780 CMR 3 Use or Occupancy
780 CMR 4 Special Use and Occupancy
780 CMR 5 General Building Limitations
780 CMR 7 Fireresistant Materials and Construction
780 CMR 9 Fire Protection Systems
780 CMR 10 Means of Egress
780 CMR 13 Energy Conservation
780 CMR 14 Exterior Wall Coverings
780 CMR 16 Structural Loads
780 CMR 18 Foundations and Retaining Walls
780 CMR 28 Mechanical Systems
780 CMR 34 Repair, Alteration, Additon & Change of Use of Existing Structures
780 CMR 36 One & Two Family Dwelling
780 CMR APPENDIX A - Reference Standards
780 CMR APPENDIX B - Sample Building Permit Application Forms
780 CMR APPENDIX H - Historic Buildings
780 CMR APPENDIX J - Energy Provisions
780 CMR R6 -Registration and Enforcement of Home Improvement Contractor Program
780 CMR R7-Certification of Inspectors of Bulldings, Building Commissions and Local Inspectors

Under the Provisions of Massachusetts General Laws, Chapter 30A, § 6, and Chapter 233, § 75, this document may be used as evidence of the original documents on file with the Secretary of the Commonwealth.

Compiled as in full force and effect: **09/09/05**

BUILDING CODE 6/BX
BUILDCODE8.8.05
40089
$30.00

A true copy attest:

William Francis Galvin

WILLIAM FRANCIS GALVIN
Secretary of the Commonwealth

THE COMMONWEALTH OF MASSACHUSETTS
William Francis Galvin, Secretary of the Commonwealth
State Publications and Regulations

REGULATION FILING AND PUBLICATION

1. Regulation Chapter, Number & Heading: **780 CMR**

2. Name of Agency: **THE MASSACHUSETTS STATE BUILDING CODE**
STATE BOARD OF BUILDING REGULATIONS & STANDARDS

3. This document is reprinted from the Code of Massachusetts Regulations and contains the following:

This is the
Sixth Edition of the Massachusetts State Building Code
as adopted by the
State Board of Building Regulations and Standards and filed with the
Office of the Secretary of the Commonwealth

Under the Provisions of Massachusetts General Laws, Chapter 30A, § 6, and Chapter 233, § 75, this document may be used as evidence of the original documents on file with the Secretary of the Commonwealth.

Compiled as in full force and effect: **09/09/2005**

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WILLIAM FRANCIS GALVIN
Secretary of the Commonwealth

#328

THE COMMONWEALTH OF MASSACHUSETTS
William Francis Galvin
Secretary of the Commonwealth

Regulation Filing *To be completed by filing agency*

CHAPTER NUMBER: 780 CMR 1

CHAPTER TITLE: Administration

AGENCY: Department of Public Safety / Board of Building Regulations and Standards

SUMMARY OF REGULATION: *State the general requirements and purposes of this regulation.*

These Regulations add requirements for board up/marking procedures of unsafe buildings.

REGULATORY AUTHORITY: c. 802 of the acts of 1972, as amended and MGL c.143 Sections 93-100

AGENCY CONTACT: Robert Anderson PHONE: 617-727-3200

ADDRESS: One Ashburton Plc, Rm 1301, Boston, MA 02108

Compliance with M.G.L. c. 30A

EMERGENCY ADOPTION - *If this regulation is adopted as an emergency, state the nature of the emergency.*

PRIOR NOTIFICATION AND/OR APPROVAL - *If prior notification to and/or approval of the Governor, Legislature or others was required, list each notification, and/or approval and date, including notice to the Local Government Advisory Commission.*

Local Government Notice on 4/21/04 and 10/18/04, respectively

PUBLIC REVIEW- *M.G.L. c. 30A. §§ 2 and/or 3 requires notice of the hearing or comment period be filed with the Secretary of the Commonwealth, published in appropriate newspapers, and set to persons to whom specific notice must be given at least 21 days prior to such hearing or comment period.*

Date of public hearing or comment period: Comment Period thru 6/11/04 and 12/9/04 respectively

FISCAL EFFECT - *Estimate the fiscal effect of the public and private sectors.*

For the first and second year: No estimate available but driven by fire-related issues tied to the Worcester coldstorage building fire.

For the first five years: No estimate available but driven by fire-related issues tied to the Worcester coldstorage building fire

No fiscal effect: No estimate available but driven by fire-related issues tied to the Worcester coldstorage building fire

SMALL BUSINESS IMPACT - *State the impact of this regulation on small business. Include a description of reporting, record keeping and other compliance requirements as well as the appropriateness of performance versus design standards and whether this regulation duplicates or conflicts with any other regulation. If the purpose of this regulation is to set rates for the state, this section does not apply.*

No estimate available but driven by fire-related issues tied to the Worcester coldstorage building fire

CODE OF MASSACHUSETTS REGULATIONS INDEX - *List key subjects that are relevant to this regulation:*

780 CMR 121.7 - window/door openings, building board-up; 780 CMR 121.8 - unsafe building(s)

PROMULGATION - *State the action taken by this regulation and its effect on existing provisions of the Code of Massachusetts Regulations (CMR) to repeal, replace or amend. List by CMR number:*

Amends 780 CMR 1 Section 121

ATTESTATION - *The regulation described herein and attached hereto is a true copy of the regulation adopted by this agency.* ATTEST:

SIGNATURE: DATE: 8/26/05

Publication - *To be completed by the Regulations Division*

MASSACHUSETTS REGISTER NUMBER: #1034 DATE: 9/9/05

EFFECTIVE DATE: 9/9/05

CODE OF MASSACHUSETTS REGULATIONS

Remove these pages:	*Insert these pages:*
1 - 4	1 - 4
7 - 10	7 - 10
27, 28	27, 28.2

A TRUE COPY ATTEST

William Francis Galvin

WILLIAM FRANCIS GALVIN
SECRETARY OF THE COMMONWEALTH
DATE 8/26/05 CLERK

THE COMMONWEALTH OF MASSACHUSETTS
William Francis Galvin, Secretary of the Commonwealth
State Publications and Regulations

REGULATION FILING AND PUBLICATION

1. Regulation Chapter, Number & Heading: **780 CMR**
AMENDMENT (04/26/01)

2. Name of Agency: **THE MASSACHUSETTS STATE BUILDING CODE**
STATE BOARD OF BUILDING REGULATIONS & STANDARDS

3. This document is reprinted from the Code of Massachusetts Regulations and contains the following:

780 CMR 13 Energy Conservation

Under the Provisions of Massachusetts General Laws, Chapter 30A, § 6, and Chapter 233, § 75, this document may be used as evidence of the original documents on file with the Secretary of the Commonwealth.

Compiled as in full force and effect: **04/26/2001**

A true copy attest:
William Francis Galvin
WILLIAM FRANCIS GALVIN
Secretary of the Commonwealth

#253

THE COMMONWEALTH OF MASSACHUSETTS

Office of the Secretary of State

Notice of Compliance

Regulation Filing *To be completed by filing agency*

CHAPTER NUMBER: 780 CMR 13

CHAPTER TITLE: Energy Conservation

AGENCY: State Board of Building Regulations and Standards

THIS REGULATION WAS ORIGINALLY ADOPTED AS AN EMERGENCY:

Published in the Massachusetts Register Number: 921 *Date:* 5/11/01

PRIOR NOTIFICATION AND/OR APPROVAL

If prior notification to and/or approval of the Governor, legislature or others was required, list each notification, approval and date, including notice to the Local Government Advisory Commission:

Notice to Local Government Advisory Commission- March 31, 2001

PUBLIC REVIEW

Was notice of the hearing or comment period filed with the Secretary of State, published in appropriate newspapers and sent to persons to whom specific notice must be given at least 21 days prior to such hearing or comment period?

Yes Date of public hearing or comment period May 8, 2001

Publication To be completed by the Regulations Division.

MASSACHUSETTS REGISTER NUMBER: 923 DATE: 6/8/01

EFFECTIVE DATE: 4/26/01

CODE OF MASSACHUSETTS REGULATIONS

Remove these pages CMR: Vol.	Insert these pages
3,4	3,4
209,210	209,210
215 218	215 218
221 - 234	221 - 234
237,238	237,238
242.5 - 242.8	242.5 - 242.8

TRUE COPY ATTEST

William Francis Galvin

WILLIAM FRANCIS GALVIN
SECRETARY OF THE COMMONWEALTH

5/21/01 CLERK

ATTACHMENT 1

(key subject entries that are relevant to this regulation)

Implementation date for new commercial energy code; HVAC equipment performance requirements; construction documents; building official approval; plans; definitions; slab-on-grade; moisture control; pre-engineered metal buildings; building envelope; non-glazed doors; below grade walls; air barriers; fenestration and doors; weatherseals; shafts, chutes, stairwell and lobby doors; vestibules; insulation protection; ventilation controls; lighting power densities; interior lighting power; total energy use

ATTACHMENT 2

(State the action taken by this regulation and its effect on the existing provisions of the Code of Massachusetts Regulations (CMR) to repeal, replace or amend. List by CMR number)

Amends:

780 CMR 1300;
780 CMR 1301.8.2
780 CMR 1301.8.4
780 CMR 1302
780 CMR 1304
780 CMR 1304.1.2
780 CMR 1304.1.2 (by adding an EXCEPTION)
780 CMR Tables 1304.2.1 through 1304.2.12
780 CMR 1304.2.2
780 CMR 1304.2.9
780 CMR 1304.3.1
780 CMR 1304.3.3
780 CMR 1304.3.4
780 CMR 1304.3.6
780 CMR 1304.4.5
780 CMR 1305.3.6.2
780 CMR Table 1308.6.2.2
780 CMR 1308.6.2.3
780 CMR 1309.1

THE COMMONWEALTH OF MASSACHUSETTS
William Francis Galvin, Secretary of the Commonwealth
State Publications and Regulations

REGULATION FILING AND PUBLICATION

1. Regulation Chapter, Number & Heading: **780 CMR**

2. Name of Agency: **THE MASSACHUSETTS STATE BUILDING CODE
STATE BOARD OF BUILDING REGULATIONS & STANDARDS**

3. This document is reprinted from the Code of Massachusetts Regulations and contains the following:

**This is the
Sixth Edition of the Massachusetts State Building Code
as adopted by the
State Board of Building Regulations and Standards and filed with the
Office of the Secretary of the Commonwealth**

Under the Provisions of Massachusetts General Laws, Chapter 30A, § 6, and Chapter 233, § 75, this document may be used as evidence of the original documents on file with the Secretary of the Commonwealth.

Compiled as in full force and effect: **01/19/01**

BUILDING CODE 6TH.
BLDGCODE6THEDIT
100330 $30.00

A true copy attest:
William Francis Galvin
WILLIAM FRANCIS GALVIN
Secretary of the Commonwealth

THE MASSACHUSETTS STATE BUILDING CODE

780 CMR

Sixth Edition

COMMONWEALTH OF MASSACHUSETTS

Published by
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Secretary of the Commonwealth

FOREWORD and ACKNOWLEDGMENTS

THE MASSACHUSETTS STATE BUILDING CODE (780 CMR), *SIXTH EDITION*

FOREWORD

The *Sixth Edition* of 780 CMR ,the Massachusetts State Building Code has been revised from the *Fifth Edition* to make it consistent with the common code format of the National Code, the Uniform Building Code and the Southern Building Code, both in chapter and sub-chapter numbering. The technical content is based on the 1993 edition of the Building Officials and Code Administrators (BOCA) National Building Code. Extensive technical changes have been made as a result of reviews by the BBRS technical advisory committees, listed in this section, and also as required by Massachusetts General Laws and Specialized Codes and Regulations.

Chapter 36, *the One and Two Family Dwelling Code*, has been revised from the *Fifth* to the *Sixth Edition* to make it consistent with the 1995 edition of the CABO One and Two Family Dwelling Code to the extent practicable. Substantive changes have been made as a result of reviews by the BBRS staff, state and municipal building officials, and technical advisory boards.

The following chapters are considered unique to the Commonwealth of Massachusetts, in their entirety:

Chapter 1	-	Administration
Chapter 9	-	Fire Protection Systems
Chapter 11	-	Accessibility
Chapter 13	-	Energy Conservation
Chapter 16	-	Structural Loads
Chapter 18	-	Foundations and Retaining Walls
Chapter 27	-	Electrical Wiring and Equipment
Chapter 29	-	Plumbing and Gasfitting
Chapter 30	-	Elevator and Conveying Systems
Chapter 34	-	Repair, Alteration and Change of Use of Existing Buildings
Chapter 35	-	Manufactured Buildings, Building Components and Mobile Homes

Several differences appear in the format of the *Sixth Edition* from that of the *Fifth Edition*; a major change pertaining to the numbering system. Other changes in the content of the *Sixth Edition* that are different from that of national building code, are shown in ***bold-faced, italicized type***. Chapters which are significantly different than the national building code are identified with the parenthetical statement ***This Chapter is Entirely Unique to Massachusetts***.

The *Sixth Edition* of the Massachusetts State Building Code (780 CMR) becomes effective on February 28, 1997.

In recognition of the time periods involved in the planning, design and construction of buildings and building related projects and in order to effect an orderly and equitable transition between the *Fifth Edition* and *Sixth Edition*, the State Board of Building Regulations and Standards implements the following policy;

From February 28, 1997 to August 27, 1997 the *Fifth* and *Sixth Editions* of the Massachusetts State Building Code shall be considered to be concurrently effective. During this period, the end user may elect to utilize the provisions of either the *Fifth Edition* in its entirety or the *Sixth Edition* in its entirety.

The *Fifth Edition* will be automatically repealed on August 27, 1997 after which date all users shall comply with the provisions of the *Sixth Edition*.

PURCHASING OPTIONS

The ***One and Two-Family Dwelling Code***, identified in the *Sixth Edition* as Chapter 36, may be purchased as a separate package, including Chapter 1, Administration and Enforcement and Appendix A, or it may be purchased as part of the entire code package.

The ***Rules and Regulations of the Board of Building Regulations and Standards*** identified as 780 CMR-R1 through 780 CMR-R7, may be purchased as a separate package or as part of the entire code package.

Also available is the ***Guide to the Sixth Edition of the Massachusetts State Building Code***, This guide was developed to assist code users in making the transition between the *Fifth Edition* and *Sixth Edition* and is sold as part of the code. It includes a ***Chapter\Article Number Cross Reference-Index*** and a ***Summary of Major Changes*** made in the *Sixth Edition* relative to the *Fifth Edition* and the national building code.

The code may be ordered in any manner identified above by calling the State House Bookstore @ (617) 727-2834.

AMENDMENT PROCESS

Pursuant to M.GL. c. 143, § 97, 780 CMR is subject to change by amendment. Amendments shall be proposed on forms made available at the office of the Board of Building Regulations and Standards. Proposals are offered at public hearing where the Board hears testimony both for and against the proposals. Proposals are then studied and voted upon by the Board. Those that are voted "approved" are issued as amendments to 780 CMR and become effective when published in the Bi-weekly ***MASSACHUSETTS REGISTER***.

All proposals for amendment to 780 CMR must be received at least 60 days prior to the public hearing date. Changes that are voted "approved" are issued on a cycle determined by the Board; generally not sooner than a two year cycle.

The Board convenes public hearings to entertain changes to the code a minimum of twice each calendar year; in May and November. Other public hearings may be scheduled as necessary.

Anyone wishing to present a code change proposal should contact the Office of the Board at (617) 727-3200 extension 614 for information on how to file. It is the responsibility of the code user to check the **MASSACHUSETTS REGISTER** periodically to determine if amendments have been issued.

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Ken Wade
Representative of the Attorney General

TECHNICAL CODE COUNCIL

Pursuant to M.G.L. c. 143, § 3, there shall be an advisory board known as the technical code council which shall make recommendations relative to the formulation, promulgation and administration of the state building code. The make-up of the council is available at the Office of the Board of Building Regulations and Standards.

TABLE OF CONTENTS

Page

Chapter 1: ADMINISTRATION 13
(This chapter is entirely unique to Massachusetts)

101.0: Scope 13
102.0: Applicability 13
103.0: Maintenance 14
104.0: Validity 14
105.0: Office of the inspector of buildings or building commissioner 14
106.0: Duties and powers of the building official 15
107.0: Duties and powers of the state inspector 17
108.0: Rules & regulations 18
109.0: Approval 19
110.0: Application for permit 19
111.0: Permits 21
112.0: Demolition of structures 23
113.0: Conditions of permit 23
114.0: Fees 23
115.0: Inspection 24
116.0: Registered architectural and professional engineering services - construction control 24
117.0: Workmanship 26
118.0: Violations 26
119.0: Stop work order 26
120.0: Certificate of occupancy 27
121.0: Unsafe structures 27
122.0: Board of appeals 28.1
123.0: Construction Materials safety Board 32.
124.0: Fire Prevention - Fire Protection Advisory Committee 32
125.0: Structural Peer Review Advisory Committee 32

Chapter 2: DEFINITIONS 35

201.0: General 35
202.0: General Definitions 35

Chapter 3: USE OR OCCUPANCY 47

301.0: General 47
302.0: Classification 47
303.0: Assembly use groups 48
304.0: Business use group 49
305.0: Educational use group 49
306.0: Factory and industrial use groups 49
307.0: High hazard use groups 50
308.0: Institutional use groups 54
309.0: Mercantile use group 57
310.0: Residential use groups 58
311.0: Storage use groups 59
312.0: Utility and miscellaneous use group 59
313.0: Mixed use groups 59

Chapter 4: SPECIAL USE AND OCCUPANCY 63

401.0: General 63
402.0: Covered mall buildings 63
403.0: High rise buildings 65
404.0: Atriums 67
405.0: Underground structures 68
406.0: Open parking structures 69
407.0: Private garages 70
408.0: Public garages 70
409.0: Use Group I-2 71

TABLE OF CONTENTS - continued

Page

Chapter 4: SPECIAL USE AND OCCUPANCY - continued

410.0: Use Group I-3 72
411.0: Motion picture projection rooms, screening rooms and sound stages 74
412.0: Stages and platforms 75
413.0: Special amusement buildings 78
414.0: Airport traffic control towers 78
415.0: Outdoor processing facilities 79
416.0: HPM facilities 79
417.0: Hazardous materials 83
418.0: Use Groups H-1, H-2, H-3 and H-4 85
419.0: Application of flammable finishes 88
420.0: Mobile units 88
421.0: Swimming pools 88
422.0: Existing buildings 92
423.0: Group Residences 93
424.0: Day Care Centers 95
425.0: Summer Camps for Children 99
426.0: Bulk Merchandising Retail Buildings 99
427.0: Limited Group Residences 104
428.0: Detoxification Facilities 107
429.0: Group Dwelling Units 109

Chapter 5: GENERAL BUILDING LIMITATIONS 113

501.0: General 113
502.0: Definitions 113
503.0: General height and area limitations 113
504.0: Height modifications 115
505.0: Mezzanines 116
506.0: Area modifications 116
507.0: Unlimited areas 117

Chapter 6: TYPES OF CONSTRUCTION 119

601.0: General 119
602.0: Construction classification 119
603.0: Types 1 and 2 construction 121
604.0: Type 3 construction 121
605.0: Type 4 construction 121
606.0: Type 5 construction 121

Chapter 7: FIRERESISTANT MATERIALS AND CONSTRUCTION 123

701.0: General 123
702.0: Definitions 123
703.0: Construction documents 124
704.0: Fire tests 124
705.0: Exterior walls 125
706.0: Exterior opening protectives 128
707.0: Fire walls and party walls 128
708.0: Fire wall openings 130
709.0: Fire separation assemblies 130
710.0: Vertical shafts 132
711.0: Fire partitions 133
712.0: Smoke barriers 133
713.0: Floor/ceiling and roof/ceiling assemblies 134
714.0: Roof construction 136

TABLE OF CONTENTS - continued

Page

Chapter 7: FIRERESISTANT MATERIALS AND CONSTRUCTION - continued

715.0: Fireresistance rating of structural members 137
716.0: Fire door assemblies 137
717.0: Fire dampers 138
718.0: Fire windows and shutters 139
719.0: Wired glass 139
720.0: Firestopping and draftstopping 140
721.0: Fireresistive requirements for plaster 141
722.0: Thermal- and sound-insulating materials 142

Chapter 8: INTERIOR FINISHES 143

801.0: General 143
802.0: Definitions 143
803.0: Interior finish and trim 143
804.0: Application of interior finish 144
805.0: Floor finish 145
806.0: Combustible materials permitted in floors of type 1 and 2 construction 146
807.0: Interior hangings and decorations 146

Chapter 9: FIRE PROTECTION SYSTEMS 147
(This chapter is entirely unique to Massachusetts)

901.0: General 147
902.0: Definitions 147
903.0: Fire protection systems approval/acceptance 149
904.0: Fire suppression systems 151
905.0: Suppression system agent compatibility 152.1
906.0: Fire sprinkler system 152.1
907.0: Limited area sprinkler systems 154
908.0: Water-spray fixed systems 154
909.0: Carbon dioxide extinguishing systems 155
910.0: Dry-chemical extinguishing systems 155
911.0: Foam extinguishing systems 156
912.0: Halogenated extinguishing systems 156
913.0: Wet-chemical range hood extinguishing systems 157
914.0: Standpipe systems 157
915.0: Fire department connections 158
916.0: Yard hydrants/underground fire mains 159
917.0: Fire protective signaling systems (Fire alarm systems) 159
918.0: Automatic fire detection systems 162
919.0: Single- and multiple-station smoke detectors 164
920.0: Fire extinguishers 164
921.0: Smoke control systems 165
922.0: Smoke and heat vents 167
923.0: Supervision 168
924.0: Fire pumps 168

Chapter 10: MEANS OF EGRESS 171

1001.0: General 171
1002.0: Definitions 171
1003.0: Construction documents 172
1004.0: Use group and occupancy requirements 172
1005.0: General limitations 172
1006.0: Types and location of means of egress 173
1007.0: Accessible means of egress 175
1008.0: Occupant load 176
1009.0: Capacity of egress components 177
1010.0: Number of exits 177
1011.0: Exit access passageways and corridors 178

TABLE OF CONTENTS - continued

Page

Chapter 10: MEANS OF EGRESS - continued

1012.0: Assembly aisles and aisle accessways 180
1013.0: Grandstands 182
1014.0: Stairways 183
1015.0: Smokeproof enclosures 187
1016.0: Ramps 189
1017.0: Means of egress doorways 189
1018.0: Revolving doors 190
1019.0: Horizontal exits 194
1020.0: Level of exit discharge passageways used as an exit element 195
1021.0: Guards 195
1022.0: Handrails 196
1023.0: Exit signs and lights 196
1024.0: Means of egress lighting 197
1025.0: Fire escapes 197
1026.0: Slidescapes 198
1027.0: Access to roof 198
1028.0: Maintenance of exits 199

Chapter 11: ACCESSIBILITY 201
(780 CMR 11 is Entirely Unique to Massachusetts)

Chapter 12: INTERIOR ENVIRONMENT 203

1201.0: General 203
1202.0: Definitions 203
1203.0: Construction documents 203
1204.0: Room dimensions 203
1205.0: Light and ventilation required 204
1206.0: Natural light 204
1207.0: Artificial light 204
1208.0: Natural ventilation 204
1209.0: Mechanical ventilation 205
1210.0: Ventilation of special spaces 205
1211.0: Access to crawl spaces and attics 205
1212.0: Courts and yards 205
1213.0: Obstruction of courts and yards 206
1214.0: Sound transmission control in residential buildings 206
1215.0: Ratproofing 207

Chapter 13: ENERGY CONSERVATION 209
(This chapter is entirely unique to Massachusetts)

1301.0: Administration 209
1302.0: Definitions 213
1303.0: Design conditions 220
1304.0: Building envelope requirements 221
1305.0: Heating, ventilation and air conditioning 231
1306.0: Service water heating 241
1307.0: Electric power distribution 242
1308.0: Lighting systems 242.1
1309.0: Building design by systems analysis 242.7

TABLE OF CONTENTS - continued

Page

Chapter 14: EXTERIOR WALL COVERINGS 243

1401.0: General 243
1402.0: Definitions 243
1403.0: Performance requirements 243
1404.0: Materials 243
1405.0: Veneers 244
1406.0: Combustible materials on the exterior side of exterior walls 248

Chapter 15: ROOF AND ROOF COVERINGS 251

1501.0: General 251
1502.0: Definitions 251
1503.0: Construction documents 251
1504.0: Weather protection 251
1505.0: Performance requirements 251
1506.0: Fire classification 252
1507.0: Prescriptive requirements 252
1508.0: Flashings 254
1509.0: Roof insulation 255
1510.0: Roof structures 255
1511.0: Rooftop heliports 256
1512.0: Reroofing 256

Chapter 16: STRUCTURAL LOADS 257
(This chapter is entirely unique to Massachusetts)

1601.0: General 257
1602.0: Definitions 257
1603.0: Construction documents 257
1604.0: Design safe load 258
1605.0: Design dead load 258
1606.0: Uniformly distributed live loads 258
1607.0: Design live load 259
1608.0: Live load reduction 259
1609.0: Roof loads 260
1610.0: Snow loads 261
1611.0: Wind loads 271
1612.0: Earthquake loads 278
1613.0: Concentrated loads 296
1614.0: Impact loads 297
1615.0: Special loads 297
1616.0: Combination of loads 298
1617.0: Existing buildings 299

Chapter 17: STRUCTURAL TESTS AND INSPECTIONS 301
(Substantial portions of this chapter are unique to Massachusetts)

1701.0: General 301
1702.0: Definitions 301
1703.0: Information required 301
1704.0: Approvals 302
1705.0: Requirements for special tests and inspections 302
1706.0: Design strength of materials 306
1707.0: Alternative test procedure 306
1708.0: Test safe load 306
1709.0: In-situ load tests 306
1710.0: Preconstruction load tests 307

TABLE OF CONTENTS - continued

Page

Chapter 18: FOUNDATIONS AND RETAINING WALLS 309
(This chapter is entirely unique to Massachusetts)

1801.0: General 309
1802.0: Foundation investigations 309
1803.0: Soil bearing test 309
1804.0: Load bearing value of soils 310
1805.0: Allowable foundation loads 312
1806.0: Depth of footings 313
1807.0: Footing design 313
1808.0: Timber footings and wood foundations 314
1809.0: Steel grillages 314
1810.0: Concrete footings 314
1811.0: Masonry unit footings 315
1812.0: Foundation walls 315
1813.0: Waterproofing and dampproofing 316
1814.0: Mat, raft and float foundation 318
1815.0: Pier foundations 318
1816.0: Pile foundations 320
1817.0: Allowable pile loads 323
1818.0: Structural steel piles 326
1819.0: Concrete-filled steel pipe and tube piles 326
1820.0: Cast-in-place concrete piles 327
1821.0: Precast concrete piles 332
1822.0: Timber piles 332
1823.0: Composite piles 333
1824.0: Concrete filled pipe with core caissons 333
1825.0: Retaining walls 334

Chapter 19: CONCRETE 335

1901.0: Concrete design standards 335
1902.0: Definitions 335
1903.0: Seismic requirements for reinforced concrete 335
1904.0: Seismic requirements for plain concrete 338
1905.0: Minimum slab thickness 339
1906.0: Materials 339
1907.0: Durability requirements 340
1908.0: Concrete quality, mixing and placing 343
1909.0: Formwork, embedded pipes, and construction joints 345
1910.0: Details of reinforcement 346
1911.0: Shotcrete 348
1912.0: Concrete-filled pipe columns 348

Chapter 20: LIGHTWEIGHT METALS 351

2001.0 General 351
2002.0 Materials 351

Chapter 21: MASONRY 353

2101.0: General 353
2102.0: Definitions 253
2103.0: Construction documents 355
2104.0: Seismic requirements 355
2105.0: Masonry construction materials 357
2106.0: Lateral stability 359
2107.0: Compressive stress requirements 360
2108.0: Lateral support 360
2109.0: Thickness of masonry 361
2110.0: Bond 361

TABLE OF CONTENTS - continued

Page

Chapter 21: MASONRY - continued

2111.0: Anchorage 362
2112.0: Masonry construction 363
2113.0: Miscellaneous requirements 364
2114.0: Fireplaces and chimneys 364
2115.0: Glass block walls 365

Chapter 22: STEEL 367

2201.0: General 367
2202.0: Definitions 367
2203.0: Structural steel construction 367
2204.0: Seismic requirements for structural steel 369
2205.0: Open web steel joist construction 369
2206.0: Formed steel construction 369
2207.0: Special steel and steel cable structural systems 370
2208.0: Reinforcing steel 371
2209.0: Cast steel construction 371
2210.0: Cast iron construction 371

Chapter 23: WOOD 373

2301.0: General 373
2302.0: Definitions 373
2303.0: Performance requirements 373
2304.0: Heavy timber construction 374
2305.0: Wood frame construction 375
2306.0: Seismic requirements for wood and timber 381
2307.0: Wood structural panels 388
2308.0: Particleboard 390
2309.0: Fiber boards 391
2310.0: Fireretardant treated wood 392
2311.0: Naturally durable and preservative treated wood 393
2312.0: Joist hangers 394
2313.0: Prefabricated components 395

Chapter 24: GLASS AND GLAZING 397

2401.0: General 397
2402.0: General requirements for glass 397
2403.0: Wind, snow and dead loads on glass 397
2404.0: Sloped glazing and skylights 399
2405.0: Safety glazing 399
2406.0: Glass in handrails and guardrails 401
2407.0: Glazing in racquetball and squash courts 401

Chapter 25: GYPSUM BOARD AND PLASTER 403

2501.0: General 403
2502.0: Shear walls 403
2503.0: Gypsum board materials 403
2504.0: Gypsum construction 405
2505.0: Interior lathing and gypsum plastering 405
2506.0: Portland cement stucco lathing and plastering 405

TABLE OF CONTENTS - continued

Page

Chapter 26: PLASTIC 407

2601.0: General 407
2602.0: Definitions 407
2603.0: Foam plastic 407
2604.0: General requirements for light transmitting plastics 409
2605.0: Light-transmitting wall panels 410
2606.0: Light-transmitting plastic glazing of unprotected openings 411
2607.0: Light-transmitting plastic roof panels 411
2608.0: Light-transmitting skylight glazing 412

Chapter 27: ELECTRICAL WIRING, EQUIPMENT AND SYSTEMS 415
(This chapter is entirely unique to Massachusetts)

Chapter 28: MECHANICAL SYSTEMS 417

2801.0: General 417
2802.0: Construction documents 418
2803.0: Fees 418
2804.0: Inspections and tests 418
2805.0: Plenums 418
2806.0: Drying rooms 418.1
2807.0: Waste and linen handling systems 418.1
2808.0: Refuse vaults 419
2809.0: Medical gases 419
2810.0: Oxygen systems 419
2811.0: Existing buildings 419
2812.0: Power ventors 419
28.13.0: Solid fuel-fired appliances 420

Chapter 29: PLUMBING SYSTEMS 421
(This chapter is entirely unique to Massachusetts)

Chapter 30: ELEVATORS AND CONVEYING SYSTEMS 423
(This chapter is entirely unique to Massachusetts)

3001.0: General 423

Chapter 31: SPECIAL CONSTRUCTION 425

3101.0: General 425
3102.0: Signs 425
3103.0: Membrane structures 428
3104.0: Temporary structures 430
3105.0: Canopies and awnings 430
3106.0: Pedestrian walkways 431
3107.0: Flood-resistant construction 432
3108.0: Radio and television towers 436
3109.0: Radio and television antennas 436
3110.0: Window-cleaning safeguards 436

Chapter 32: CONSTRUCTION IN THE PUBLIC RIGHT- OF- WAY 437

3201.0: General 437
3202.0: Street encroachments 437
3203.0: Permissible street projections 437
3204.0: Special and temporary projections 438
3205.0: Awnings and canopies 438

TABLE OF CONTENTS - continued

Page

Chapter 33 SITE WORK, DEMOLITION AND CONSTRUCTION 441

3301.0: General 441
3302.0: Construction documents and special permits 441
3303.0: Tests 441
3304.0: Protection of public 441
3305.0: Fire hazards 442
3306.0: Maintenance 442
3307.0: Health hazards 442
3308.0: Protection of adjoining property 443
3309.0: Existing buildings 443
3310.0: Demolition and excavation 443
3311.0: Retaining walls and partition fences 444
3312.0: Storage of materials and construction equipment 444
3313.0: Removal of waste material 444
3314.0: Stairways 444
3315.0: Lighting 444

Chapter 34 REPAIR, ALTERATION, ADDITION AND CHANGE OF USE OF EXISTING STRUCTURES 445
(This chapter is entirely unique to Massachusetts)

3400.0: Scope 445
3401.0: Definitions 446
3402.0: Implementation 447
3403.0: Hazard index 448
3404.0: Requirements for continuation of the same use group or change to a use group resulting in a change in hazard index of one or less 448
3405.0: Requirements for change in use group to two or more hazard indices greater 449
3406.0: Compliance alternatives 450
3407.0: Energy provisions for existing buildings 450
3408.0: Structural requirements for existing buildings 451
3409.0: Historic buildings 458

Chapter 35: MANUFACTURED BUILDINGS, MANUFACTURED BUILDING COMPONENTS AND MANUFACTURED HOUSING 461
(This chapter is entirely unique to Massachusetts)

3501.0: General 461
3502.0: Definitions 461
3503.0: Construction documents 462
3504.0: Approval 462
3505.0: Certification 463
3506.0: Reciprocity 463
3507.0: Assurance inspection 463
3508.0: Responsibility of the local enforcement agencies 463
3509.0: Suspension or revocation of certification 464

Chapter 36: ONE AND TWO FAMILY DWELLINGS 465

3601.0: One and two family dwelling code - general administration 465
  3601.1: General 465
  3601.2: Purpose 465
3602.0: Building definitions 467
  3602.1: General 467
  3602.2: General building definitions 467
3603.0: Building Planning 469
  3603.1: Structural Design Criteria 469
  3603.2: Construction in Areas Subject to Flooding 474
  3603.3: Fireresistance rating of exterior walls 474
  3603.4: Dwelling unit separation 474

TABLE OF CONTENTS - continued

Page

Chapter 36: ONE AND TWO FAMILY DWELLINGS - continued

- 3603.6: Light, ventilation and heating 474
  - 3603.6.4: Natural light 475
  - 3603.6.5: Artificial light 475
  - 3603.6.6: Natural ventilation 476
  - 3603.6.7: Mechanical ventilation 476
  - 3603.6.8: Ventilation of special spaces 476
- 3603.7: Room dimensions 477
- 3603.8: Ceiling height requirements 477
- 3603.9: Access to crawl spaces and attics 477
- 3603.10: Means of Egress 477
- 3603.11: Doors and hallways 478
- 3603.12: Landings 478
- 3603.13: Stairways 478
- 3603.14: Handrails and guardrails 479
- 3603.15: Ramps 479
- 3603.16: Fire protection systems 480
- 3603.17: Foam plastic 481
- 3603.18: Interior finish requirements/flame spread and smoke developed 482
- 3603.19: Insulation/flame spread, smoke developed/critical radiant flux 482
- 3603.20: Glazing 482
  - 3603.20.4: Safety glazing 483
  - 3603.20.5: Sloped glazing and skylights 484
- 3603.21: Energy conservation requirements 485
- 3603.22: Protection against decay and termites 485
- 3603.23: Manufactured buildings and manufactured housing 486
- 3603.24: Sanitation 487
- 3603.25: Electrical requirements 487

3604.0: Foundations 489
- 3604.1: General 489
- 3604.2: Materials 490
- 3604.3: Footings 490
- 3604.4: Foundation walls 494
- 3604.5: Foundation drainage 497
- 3604.6: Foundation waterproofing and dampproofing 498
- 3604.7: Foundation insulation 499
- 3604.8: Columns 499
- 3604.9: Crawl space 499

3605.0: Floors 501
- 3605.1: General 501
- 3605.2: Floor Framing 501
- 3605.3: Floor sheathing 525
- 3605.4: Treated-wood floors (on ground) 527
- 3605.5: Concrete floors (on grade) 527
- 3605.6: Metal 528

3606.0: Wall Construction 529
- 3606.1: General 529
- 3606.2: Wall framing 529
- 3606.3: Metal 536
- 3606.4: General masonry construction 536
- 3606.5: Unit masonry 544
- 3606.6: Multiple wythe masonry 544
- 3606.7: Grouted masonry 545
- 3606.8: Windows 547
- 3606.9: Sliding glass doors 548
- 3606.10: Plywood and wood structural panels 548
- 3606.11: Particleboard 548

TABLE OF CONTENTS - continued

Page

Chapter 36: ONE AND TWO FAMILY DWELLINGS - continued

- 3607.0: Wall Covering 549
  - 3607.1: General 549
  - 3607.2: Interior covering 549
  - 3607.3: Exterior covering 552
- 3608.0: Roof-ceiling construction 557
  - 3608.1: General 557
  - 3608.2: Roof framing 557
  - 3608.3: Roof sheathing 559
  - 3608.4: Metal 560
  - 3608.5: Ceiling finishes 561
  - 3608.6: Roof ventilation 561
  - 3608.7: Attic access 561
- 3609.0: Roof coverings 591
  - 3609.1: General 591
  - 3609.2: Deck preparation 591
  - 3609.3: Asphalt shingles 591
  - 3609.4: Slate shingles 592
  - 3609.5: Metal 593
  - 3609.6: Tile, clay, or concrete shingles 593
  - 3609.7: Built-up roofing 593
  - 3609.8: Wood shingles 594
  - 3609.9: Wood shakes 594
  - 3609.10: Reroofing 596
- 3610.0: Chimneys and fireplaces 599
  - General 599
  - 3610.2 Masonry chimneys 599
  - 3610.3 Factory-built chimneys 601
  - 3610.4 Masonry fireplaces 601
  - 3610.5 Factory-built fireplaces 606
  - 3610.6 617
- 3611.0: Mechanical administration ***(This section is entirely unique to Massachusetts)*** 611
  - 3611.1: General 611
  - 3611.2: Existing mechanical systems 611
- 3612.0: Mechanical definitions 613
  - 3612.1: General 613
  - 3612.2: General mechanical definitions 613
- 3613.0: General mechanical system requirements***(This section is entirely unique to Massachusetts)*** 619
  - 3613.1: General 619
  - 3613.2: Approval 619
  - 3613.3: Labeling of equipment not under the control of 527 CMR or 248 CMR 619
  - 3613.4: Type of fuel 619
  - 3613.5: Appliance access 619
  - 3613.6: Clearances from combustible construction 619
  - 3613.7: Appliance installation 620
  - 3613.8: Control devices 622
- 3614.0: Heating and cooling equipment ***(This section is entirely unique to Massachusetts)*** 623
  - 3614.1: General 623
  - 3614.2: Heat pump equipment 624
  - 3614.3: Refrigeration cooling equipment 624
- 3615.0: Electric resistance heating 625
  - 3615.1: General 625
  - 3615.2: Radiant heating systems 625
  - 3615.3: Duct heaters 625
- 3616.0: Vented floor, wall and room heaters 627
  - 3616.1: General 627
  - 3616.2: Vented wall furnaces/additional requirements 627
  - 3616.3: Vented room heaters/additional requirements 627

TABLE OF CONTENTS - continued

Page

Chapter 36: ONE AND TWO FAMILY DWELLINGS - continued

3617.0: Ventilation air supply 629
3618.0: Exhaust systems 631
- 3618.1: Clothes dryer exhaust 631
- 3618.2: Range hoods 631
- 3618.3: Installation of microwave ovens 631
- 3618.4: Overhead ventilating hoods 631

3619.0: Duct systems 633
- 3619.1: Duct construction 633
- 3619.2: Return air 634
- 3619.3: Supply air 635

3620.0: Combustion air 637
- 3620.0: General 637
- 3620.2: All air from inside the building 637
- 3620.3: All combustion air from outside the building 637
- 3620.4: Combined use of indoor and outdoor air for combustion 638

3621.0: Chimneys and vents 643
- 3621.1: General 643
- 3621.2: Vent components 643
- 3621.3: Chimney and vent connectors 644
- 3621.4: Vents 644
- 3621.5: Masonry and factory-built chimneys 645

3622.0: Solar systems 647
- 3622.1: General 647
- 3622.3: Labeling 627
- 3622.4: Prohibited heat transfer fluids 647

LIST OF APPENDICES

A: Referenced Standards 649
B: Sample Building Permit Application Forms 669
- State Building Code Appeals Application Forms 677
- Official Interpretations 682

C: Recommended Fastening Schedule 709
D: Guidance For Selection of Foundation Material Classes in Table 1804.3 713
E: ProcedurefFor Accounting for Series and Parallel Heat Flows 715
F: Reference Data for Repair, Addition, and Change of Use of Existing Buildings 717
G: Unit Dead Loads for Design Purposes 737
H: Historic Buildings 745
I: Independent Structural Engineering Review 751
J: Energy provisions 753
K: Floor protector thermal conductivity calculations 761

780 CMR - SPECIAL RULES AND REGULATIONS

R1: Concrete Testing Laboratories Licensing 763
R2: Concrete Testing Personnel Licensing 767
R3: Manufactured Buildings, Building Components and Mobile Homes 769
R4: Use of Native Lumber 783
R5: Construction Supervisors 785
R6: Registration and Enforcement of Home Improvement Contractor Program 789
R7: Certification of Inspectors of Buildings, Building Commissioners and Local Inspectors 801

INDEX 807

CHAPTER 1

ADMINISTRATION

(Substantial portions of this Chapter are entirely unique to Massachusetts)

780 CMR 101.0 SCOPE

101.1 Title: 780 CMR shall be known as the Commonwealth of Massachusetts State Building Code.

101.2 Scope: 780 CMR, in accordance with St. 1984, c. 348, as amended shall control all matters concerning;

(a) the construction, reconstruction, alteration, repair, demolition, removal, inspection, issuance and revocation of permits or licenses, installation of equipment, classification and definition of any *building* or *structure* and use or *occupancy* of all *buildings* and *structures* or parts thereof except bridges and appurtenant supporting structures which have been or are to be constructed by, or are under the custody and control of the Department of Public Works (Massachusetts Highway Department), the Massachusetts Turnpike Authority, the Massachusetts Bay Transportation Authority, the Metropolitan District Commission, or the Massachusetts Port Authority or for which said agencies have maintenance responsibility;

(b) the rehabilitation and maintenance of *existing buildings*;

(c) the standards or requirements for materials to be used in connection therewith, including but not limited to provisions for safety, ingress and egress, energy conservation and sanitary conditions;

(d) the establishment of reasonable fees for inspections and the issuance of licenses to individuals engaged as construction supervisors;

(e) the certification of inspectors of buildings, building commissioners and local inspectors and;

(f) the registration of Home Improvement Contractors pursuant to MGL c 142A, except as such matters are otherwise provided for in the Massachusetts General Laws Annotated, or in the rules and regulations authorized for promulgation under the provisions of 780 CMR.

(g) other duties and responsibilities as defined in 780 CMR R1 through R7.

101.3 Application of references: Unless otherwise specifically provided for in 780 CMR, all references to chapter or section numbers, or to provisions not specifically identified by number, shall be construed to refer to such chapter, section or provision of 780 CMR.

101.4 Intent: 780 CMR shall be construed to secure its expressed intent, which is to insure public safety, health and welfare insofar as they are affected by building construction, through structural strength, adequate *means of egress* facilities, sanitary conditions, light and ventilation, energy conservation and fire safety; and, in general, to secure safety to life and property from all hazards incident to the design, construction, reconstruction, alteration, repair, demolition, removal, use or *occupancy* of *buildings*, *structures* or *premises*.

101.5 Specialized Codes: Specialized codes, rules or regulations pertaining to building construction, reconstruction, alteration, repair or demolition, promulgated, and under the authority of the various boards which have been authorized by the general court shall be incorporated into 780 CMR. The said specialized codes, rules or regulations include, but are not limited to, those listed in *Appendix A*.

101.6 Referenced standards: The standards referenced in 780 CMR and listed in *Appendix A* shall be considered part of the requirements of 780 CMR to the prescribed extent of each such reference. Where differences occur between provisions of 780 CMR and referenced standards, the provisions of 780 CMR shall apply. The administrative provisions of 780 CMR shall apply to all standards referenced in *Appendix A*, other than the specialized codes in 780 CMR 101.5.

780 CMR 102.0 APPLICABILITY

102.1 General: The provisions of 780 CMR shall apply to all matters affecting or relating to *buildings* and *structures*, as set forth in 780 CMR 101.0 and shall apply with equal force to municipal, county, state authorities of or established by the legislature and private *buildings* and *structures*, except where such *buildings* and *structures* are otherwise provided for by statute. The construction, reconstruction, alteration, repair, addition, change in use or *occupancy*, demolition, removal of all *buildings* and *structures* shall comply with 780 CMR.

102.2 Matters not provided for: Any requirements that are essential for the structural, fire or sanitary safety, interior climate comfort of an existing or proposed *building* or *structure*, or for the safety of the occupants thereof, which are not specifically provided for by 780 CMR, shall be determined by the building official. The State Board of Building Regulations and Standards (hereinafter referred to as the BBRS) and the Department of Public Safety shall be notified by the building official in writing within seven working days of any action taken pursuant to 780 CMR 102.2.

102.3 Zoning Bylaw Restrictions: When the provisions herein specified for structural strength, adequate egress facilities, sanitary conditions, equipment, light and ventilation, energy conservation or fire safety conflict with the local zoning bylaws or ordinances, 780 CMR shall control the construction or *alteration* of *buildings* and *structures* unless such bylaws or ordinances are promulgated in accordance with the provisions of M.G.L. c. 143, § 98 .

102.4 General bylaw restrictions: When the provisions herein specified for structural strength, adequate egress facilities, sanitary conditions, equipment, light and ventilation, energy conservation or fire safety conflict with the local general bylaws or ordinances, 780 CMR shall control the construction or *alteration* of *buildings* and *structures* unless such bylaws or ordinances are promulgated in accordance with the provisions M.G.L. c. 143, § 98.

102.5 Applicability to Existing Buildings

102.5.1 General: *Existing buildings* and *structures* shall comply with the provisions of 780 CMR 102.5 and all other applicable provisions of 780 CMR.

102.5.2 Unless specifically provided otherwise in 780 CMR, any *existing building* or *structure* shall meet and shall be presumed to meet the provisions of the applicable laws, codes, rules or regulations, bylaws or ordinances in effect at the time such *building* or *structure* was constructed or altered and shall be allowed to continue to be occupied pursuant to its use and *occupancy*, provided that the *building* or *structure* shall be maintained in accordance with 780 CMR 103.0.

102.5.3 In cases which applicable codes, rules or regulations, bylaws or ordinances were not in use at the time of such construction or alteration, the provisions of 780 CMR 103.0 shall apply.

102.5.4 In cases where the provisions of 780 CMR are less stringent than the applicable codes, rules or regulations, bylaws or ordinances at the time of such construction or substantial alteration, the applicable provisions of 780 CMR shall apply, providing such application of these provisions does not result in danger to the public, as determined by the building official.

102.5.5 *Existing buildings* or parts or portions thereof which are proposed to be enlarged, altered, repaired or changed in use or occupancy shall comply with the provisions of 780 CMR 34.

102.5.6 Moved Structures: *Buildings* or *structures* moved into or within the jurisdiction shall comply with the provisions of 780 CMR 34 provided that any new system shall comply as far as practicable with the requirements for new *structures* and provided further that the siting and *fire separation distance* comply with the requirements for new *structures.*

780 CMR 103.0 MAINTENANCE

103.1 General: All *buildings* and *structures* and all parts thereof, both existing and new, and all systems and equipment therein which are regulated by 780 CMR shall be maintained in a safe, operable and sanitary condition. All service equipment, *means of egress*, devices and safeguards which are required by 780 CMR in a *building* or *structure*, or which were required by a previous statute in a *building* or *structure*, when erected, altered or repaired, shall be maintained in good working order.

103.2 Owner responsibility: The owner, as defined in 780 CMR 2, shall be responsible for compliance with provisions of 780 CMR 103.0.

780 CMR 104.0 VALIDITY

104.1 General: The provisions of 780 CMR are severable, and if any of its provisions shall be held unconstitutional or otherwise invalid by any court of competent jurisdiction, the decision of such court shall not affect or impair any of the remaining provisions.

780 CMR 105.0 OFFICE OF THE INSPECTOR OF BUILDINGS OR BUILDING COMMISSIONER

105.1 Appointment: The chief administrative officer of each city or town shall employ and designate an inspector of buildings or building commissioner (hereinafter inspector of buildings) as well as such other local inspectors as are reasonably necessary to assist the inspector of buildings to administer and enforce 780 CMR and of M.G.L. c. 22, § 13 A and the rules and regulations made under the authority thereof. The inspector of buildings shall report directly to and be solely responsible to the appointing authority.

105.2 Alternate: The inspector of buildings is authorized to designate an alternate who shall exercise all the powers of the inspector of buildings during the temporary absence, disability or conflict of interest of the inspector of buildings. Said alternate shall be duly qualified pursuant to 780 CMR 105.3.

105.3 Qualifications of the Inspector of Buildings: In accordance with the provisions of M.G.L. c. 143, § 3, each inspector of buildings shall have had at least five years of experience in the supervision of building construction or design or in the alternative a four year undergraduate degree in a field related to building construction or design, or any combination of education and experience which would confer equivalent knowledge and ability, as determined by the BBRS. In addition each inspector of buildings shall have had general knowledge of the accepted requirements for building construction, fire prevention, light, ventilation and safe egress; as well as a general knowledge of other equipment and materials essential for safety, comfort and convenience of the occupants of a *building* or *structure*.

Each inspector of buildings shall be certified by the BBRS in accordance with the provisions of 780 CMR R7, the Rules and Regulations for the Certification of Inspectors of Buildings, Building Commissioners and Local Inspectors.

Municipalities may require additional qualifications or experience as are deemed necessary.

105.4 Qualifications of the local inspector: In accordance with the provisions of M.G.L. c. 143, § 3, each local inspector shall have had at least five years of experience in the supervision of building construction or design or in the alternative a two year associates degree in a field related to building construction or design, or any combination of education and experience which would confer equivalent knowledge and ability, as determined by the BBRS. In addition, such persons shall have had general knowledge of the accepted requirements for building construction, fire prevention, light, ventilation and safe egress; as well as a general knowledge of other equipment and materials essential for safety, comfort and convenience of the occupants of a *building* or *structure*.

Each local inspector shall be certified by the BBRS in accordance with the provisions of 780 CMR R7, the Rules and Regulations for the Certification of Inspectors of Buildings, Building Commissioners and Local Inspectors.

Municipalities may require additional qualifications or experience as are deemed necessary.

105.5 Reporting Requirements:

105.5.1 Annual report by city or town clerk: In accordance with the provisions of M.G.L. c. 143, § 3, the clerk of each city or town shall, annually, not later than April first, transmit to the BBRS the names and official address of each inspector of buildings, building commissioner and local inspector as well as at such other times as required pursuant to 780 CMR R7, the Rules and Regulations for the Certification of Inspectors of Buildings, Building Commissioners and Local Inspectors. Such reports shall be submitted on forms prescribed by the BBRS for said purpose.

105.5.2. New appointments: The clerk of each city or town shall additionally report to the BBRS, the name, capacity and status of any new appointee within the time periods prescribed in 780 CMR R7 on forms prescribed by the BBRS for said purpose.

105.6 Restriction of employees: No full-time or part-time building commissioner, inspector of buildings, or full-time or part-time local inspector as defined herein shall be engaged in, or directly or indirectly connected with, the furnishing of labor, materials or appliances for the construction, alteration or maintenance of a building or structure, or the preparation of plans or of specifications therefore within the city, town or region for which he or she is appointed, unless he or she is the owner of the building or structure; nor shall any officer or employee associated with the building department engage in any work which conflicts with his or her official duties or with the interests of the department.

Note: See M.G.L. c. 143, § 3Z (Local Option law relative to part-time employees).

105.7 Relief from personal liability: Insofar as the law allows, while acting for the municipality, the building official, charged with the enforcement of 780 CMR shall not be deemed personally liable in the discharge of his official duties.

105.8 Official records: An official record shall be kept of all business and activities of the department specified in the provisions of 780 CMR. In accordance with the provisions of M.G.L. c. 66, § 10(b), all such records shall be open to public inspection at all appropriate times and according to reasonable rules to maintain the integrity and security of such records.

780 CMR 106.0 DUTIES AND POWERS OF THE BUILDING OFFICIAL

106.1 General: The inspector of buildings and local inspector (herein after building official) shall enforce all of the provisions of 780 CMR, 521 CMR (Architectural Access Board) and any other state statutes, rules and regulations, or ordinances or bylaws which empower the building official. The building official shall act on any question relative to the mode or manner of construction and materials to be used in the construction, reconstruction, alteration, repair, demolition, removal, installation of equipment and the location, use, *occupancy* and maintenance of all *buildings* and *structures*, except as otherwise specifically provided for by statutory requirements or as provided for in 780 CMR 109.0.

106.2 Applications and permits: The building official shall receive applications and issue permits for the construction, reconstruction, alteration, repair, demolition, removal or change in use or *occupancy* of *buildings* and *structures*; inspect the *premises* for which such permits have been issued and enforce compliance with the provisions of 780 CMR.

106.3 Notices and orders: The building official shall issue all necessary notices or orders to ensure compliance with 780 CMR.

106.4 Inspections: The building official shall make such inspections as deemed necessary to ensure compliance with 780 CMR, or the building official may accept reports of inspection by qualified agencies or individuals, which reports shall be in writing and be certified by a responsible officer of such agency or by the responsible individual.

106.5 Inspection and certification of specified use groups: The building official shall periodically inspect and certify *buildings* and *structures* or parts thereof in accordance with Table 106. A *building* or *structure* shall not be occupied or continue to be occupied without the posting of a valid certificate of inspection where required by Table 106. A certificate of inspection as herein specified shall not be issued until an inspection is made certifying that the *building* or *structure* or parts thereof complies with all the applicable requirements of 780 CMR, and until the fee is paid as specified in Table 106. Municipalities may increase or waive only in their entirety for any specific *use group* the fees as specified in said Table 106.

> **Exception**: Municipalities may revise or modify, or waive in part those fees for *buildings* and *structures* or parts thereof owned by the municipality, county or political subdivision thereof and for *buildings* and *structures* or parts thereof used solely for religious purposes.

TABLE 106
REQUIRED MINIMUM INSPECTIONS AND CERTIFICATIONS FOR SPECIFIED USE GROUPS
(See Chapters 3 and 4 for complete description of *use groups*)

Use Group	Use Group	Use Group Description	Minimum Inspections	Maximum Certification Period	Fees for Maximum Certification Period
A-1	Assembly - Theaters over 400 capacity	With stage and scenery Movie Theater	Semi- Annual Semi- Annual	One Year One Year	$75 $75
A-1	Assembly - Theaters 400 or less capacity	With stage and scenery Movie Theater	Annual Annual	One Year One Year	$40 $40
A-2	Assembly - Night Clubs or similar uses	Over 400 capacity 400 or less capacity	Semi Annual Annual	One Year One Year	$75 $40
A-3	Assembly Lecture Halls, recreation centers, terminals, etc.	Over 400 capacity 400 or less capacity	Semi Annual Annual	One Year One Year	note a $40
A-4	Assembly	Churches, low density, recreation & similar uses	Prior to issuance of each new certificate	Five Years	$40
A-5	Assembly	Stadiums, bleachers, places of outdoor assembly	Prior to issuance of each new certificate	One Year	note b
"A"	Special Amusement Buildings or portions thereof (780 CMR 413.0)	Special Amusement Buildings or portions thereof (780 CMR 413.7)	Annually prior to issuance of a new certification	One Year	As established by the city or town in accordance with 780 CMR 106.5
E	Educational	Educational	Prior to issuance of each new certificate	One Year	$40
E	Day Care	Child day care centers (see Chapter 4)	Prior to issuance of each new certificate	One Year	$40
I-2	Institutional	Incapacitated - hospitals, nursing homes, mental hospitals, certain day care facilities (see Chapter 4)	Prior to issuance of each new certificate	Two Years	note d
I-3	Institutional	Restrained - prisons, jails, detention centers, etc.	Prior to issuance of each new certificate	Two Years	note c
R-1	Residential	Hotels, motels, lodging houses, dormitories, etc. (note g)	Prior to issuance of each new certificate	One Year	note e
R-2	Residential	Multi family (note g)	Prior to issuance of each new certificate	Five Years	note f
R-1	Residential Special Occupancy	Detoxification facilities (see Chapter 4)	Prior to issuance of each new certificate	Two Years	$75
R-2	Residential Special Occupancy	Summer camps for children (see chapter 4)	Annual	One Year	note h
R-3 or R-4	Residential Special Occupancy	Group Residence (see Chapter 4)	Annual	One Year	note h
R-5	Residential Special Occupancy	Limited Group Residence (see Chapter 4)	Annual	One Year	note h

Notes applicable to Table 106

General: The maximum certification period specified in Table 106 is intended to provide administrative flexibility. For those *buildings* and *structures* or parts thereof allowing more than one year maximum certification period, the building official may determine the length of validity of the certificate issued. For example, a building in the R-2 use group could be issued a certificate valid for one, two, three, four or five years. The total amount of fees charged for a certificate or certificates issued during the maximum certification period can exceed the fee listed or referenced in column 4 of Table 106. For example, if the building official issues a certificate valid for two years for a building in the R-2 use group, the fee charged would be 2/5 times the fee per maximum certification period as determined for the building in question using the formula in **Note f.**

Note a. For *buildings* or *structures*, or parts thereof, in the A-3 Use Group categories, with capacities over 400, the fee to be charged for the maximum certification period of one year is $75 for accommodations for up to 5,000 persons, plus $15 for the accommodations for each additional 1,000 persons or fraction thereof.

Note b. For all *buildings* or *structures*, or parts thereof, in A-5 use group, the fee to be charged for the maximum certification period of one year is $40 for seating accommodations for up to 5,000 persons, plus $8 for the accommodation for each additional 1,000 persons or fraction thereof.

Note c. For all *buildings* and *structures*, or parts thereof, in the I-3 use group, the fee to be charged for the maximum certification period of two years is $75 for each *structure* containing up to 100 beds, plus a $2 charge for each additional ten beds or fraction thereof over the initial 100 beds.

Note d. For hospitals, nursing homes, sanitariums, and orphanages in the I-2 use group, the fee to be charged for the maximum certification period of two years is $75 for each *structure* containing up to 100 beds, plus a $2 charge for each additional ten beds or fraction thereof over the initial 100 beds. All other *buildings* or *structures* or parts thereof in the I-2 use group classification shall be charged a fee of $75 for a two year maximum certification period.

Note e. For all *buildings* and *structures* or parts thereof in the R-1 use group, the fee to be charged for the maximum certification period of one year shall be $40 for up to five units plus $2 per unit for all over five units. A unit shall be defined as follows:

two hotel guest rooms;
two lodging house guest rooms;
two boarding house guest rooms; or
four dormitory beds

Note f. For all *buildings* and *structures* or parts thereof in the R-2 use group, the fee to be charged for the maximum certification period of five years shall be $75, plus $2 per dwelling unit except that three family dwelling units shall be exempt from such fees.

Note g. For purposes of determining the required number of inspections, the maximum certification period, and the fees, as specified in Table 106, dormitories are included in the R-1 use group classification rather than the R-2.

Note h. Summer camps for children in use group R-2 shall be inspected and certified annually prior to the beginning of each season. The annual fee shall be $15 for the first 25 residential units: $8 for each additional 25 residential units; and $15 for each assembly building or use. (A residential unit for this purpose shall be defined as four beds).

106.6 Reports by the Building Official

106.6.1 Report to Appointing Authority: The building official shall submit to the appointing authority of the jurisdiction a written report of operations in a form and content and at intervals as shall be prescribed by the appointing authority.

106.6.2 Report to assessors: Pursuant to M.G.L. c. 143, § 61, the building official shall give to the assessors of the municipality written notice of the granting of permits for the construction of any *buildings* or *structures*, or for the removal or demolition, or for any substantial alteration or addition thereto. Such notice shall be given within seven days after the granting of each permit, and shall state the name of the person to whom the permit was granted and the location of the *building* or *structure* to be constructed, reconstructed, altered, demolished or removed.

106.6.3 Report to Local United States Postmaster: Pursuant to M.G.L. c. 143, § 3X the building official shall notify the local United States Postmaster of the issuance of a building permit authorizing the construction of any *building* containing ten or more residential units.

106.7 Department records: The building official shall maintain official records of applications received, permits and certificates issued, inspections performed fees collected, reports of inspections, and notices and orders issued. Such records shall be retained in the official records as long as the *building* or *structure* to which they relate remains in existence unless otherwise provided for by law.

780 CMR 107.0 DUTIES AND POWERS OF THE STATE INSPECTOR
(M.G.L. c. 143, § 3A)

107.1 The State Inspector: In every city and town 780 CMR shall be enforced by the State Inspector of the Department of Public Safety, Division of Inspections, as to any *structures* or *buildings* or parts thereof that are owned by the Commonwealth or any departments, commissions, agencies, or authorities of the Commonwealth. The state inspector shall have as to such *buildings* and *structures* all the powers of a building commissioner or inspector of buildings. All *buildings* and *structures* owned by any authority established by the legislature and not owned by the Commonwealth shall be regulated in accordance with 780 CMR 106.0.

107.2 Other responsibilities: The state inspector shall make periodic reviews of all local building inspection practices, provide technical assistance and advice to the local building officials in the implementation of 780 CMR, and report in writing his findings to the building officials.

107.3 Review by the Commissioner of Public Safety: The Commissioner of the Commonwealth of Massachusetts, Department of Public Safety shall establish districts which shall be supervised by a state inspector of the Division of Inspections. The Commissioner may review, on his own initiative, or on the application of any state inspector, any action or refusal or failure of action by any building official the result of which does not comply with the uniform implementation of 780 CMR; and may reverse, modify or annul, in whole or in part, such action except with respect to the specialized codes, provided that an order or action of the Commissioner shall not reverse, modify, annul, or contravene any order, action, determination, interpretation or any decision by the BBRS or the State Building Code Appeals Board.

107.4 Reports: The state inspector shall file with the BBRS reports of his periodic reviews and recommendations for improvements of building inspection practices. The format and due dates for these reports shall be determined by the BBRS.

780 CMR 108.0 RULES AND REGULATIONS

108.1 Rule making authority: Under authority granted by St. 1984, c. 348, as amended, the BBRS is empowered in the interest of public safety, health and general welfare, to adopt and promulgate rules and regulations, and to interpret and implement the provisions of 780 CMR to secure the intent thereof.

108.2 Amendments and promulgation of rules: In accordance with the provisions of M.G.L. c. 143, § 97, any person may propose amendments to 780 CMR. Public hearings shall be held in the city of Boston in May and November of each year, and at such other times and places as the BBRS may determine, to consider petitions for such amendments. Amendments adopted by the BBRS shall be binding and have the full force and effect in all cities and towns.

108.3 Activities requiring licenses, registration or certification:

108.3.1 Testing laboratories: A testing laboratory, branch laboratory and/or project laboratory shall not test *concrete* and/or concrete materials for use in *structures* subject to construction control (780 CMR 116.0) and/or controlled materials (780 CMR 17) unless licensed by the BBRS in accordance with 780 CMR and 780 CMR R1: the Rules and Regulations for Licensing of Concrete Testing Laboratories.

108.3.2 Field technicians: A person shall not engage in the activities of field testing of *concrete* for use in *structures* subject to construction control (780 CMR 116.0) and/or controlled materials (780 CMR 17) unless such person is licensed by the BBRS in accordance with 780 CMR R2: the Rules and Regulations for Concrete Testing Personnel.

108.3.3 Manufactured buildings: No individual, organization or firm shall be engaged in the construction of *manufactured buildings* for use in the Commonwealth of Massachusetts unless approved to construct same by the BBRS in accordance with 780 CMR R3.

108.3.4 Native Lumber: No individual, organization or firm shall engage in the production of native lumber for use in *structures* within the Commonwealth of Massachusetts unless registered by the BBRS in accordance with 780 CMR and 780 CMR R4: the Rules and Regulations Controlling the Use of Native Lumber.

108.3.5 Licensing of Construction Supervisors:

108.3.5.1 Except for those *structures* governed by Construction Control in 780 CMR 116.0, effective July 1, 1982, no individual shall be engaged in directly supervising persons engaged in construction, reconstruction, alteration, repair, removal or demolition involving any activity regulated by any provision of 780 CMR, unless said individual is licensed in accordance the Rules and Regulations for Licensing Construction Supervisors as set forth in 780 CMR R5.

No person shall be engaged in the supervision of the field erection of a *manufactured building* unless such person is licensed in accordance with 780 CMR R5: The Rules and Regulations for the Licensing of Construction Supervisors.

Exception: Any Home Owner performing work for which a building permit is required shall be exempt from the licensing provisions of 780 CMR 108.3.5; provided that if a Home Owner engages a person(s) for hire to do such work, that such Home Owner shall act as supervisor. This exception shall not apply to the field erection of a manufactured buildings constructed pursuant to 780 CMR 35 and 780 CMR R3. For the purposes of 780 CMR 108.3.5, a "Homeowner" is defined as follows: Person(s) who owns a parcel of land on which he/she resides or intends to reside, on which there is, or is intended to be, a *one or two family dwelling*, attached or detached structures accessory to such use and/or farm structures. A person who constructs more than one home in a two-year period shall not be considered a home owner.

108.3.5.2 Exemptions from Construction Supervisor License requirement: A construction supervisor's license is not required for:

1. roofing, siding, erection of rooftop solar collectors, construction of swimming pools, the erection of signs, installation of replacement windows not involving structural modifications, the erection of tents;
2. projects which are subject to construction control (section 116.0);
3. agricultural buildings which are not open to the public or otherwise made available for public use;
4. Massachusetts registered engineers and Massachusetts registered architects provided such engineers and/or architects comply with the Construction Supervisor oversight requirements set forth in 780 CMR R5 generally and 780 CMR R5.2.12, as applicable;
5. the practice of any trade licensed by agencies of the commonwealth (see M.G.L. c.112, §81R), provided that any such work is within the scope of said license, including, but not limited to wiring, plumbing gas fitting, fire protection systems, pipefitting, HVAC and refrigeration equipment.

108.3.5.3 No municipality shall be prohibited from requiring a license for those individuals engaged in directly supervising persons engaged in construction, reconstruction, alteration, repair, removal or demolition in those categories of *building* and *structures* for which the BBRS does not require a license, provided that those municipalities which have established licensing requirements for construction supervisors prior to January 1, 1975, may maintain their existing licensing requirements.

108.3.6 Registration of Home Improvement Contractors: In accordance with the provisions of M.G.L. c. 142A, no home improvement contractor, or organization or firm shall be involved in the improvement of any existing owner occupied one to four family residential building unless said home improvement contractor has registered with the BBRS in accordance with the rules and regulations for the registration of Home Improvement Contractors as set forth in 780 CMR R6.

108.3.7 Certification of Inspectors of Buildings, Building Commissioners and Local Inspectors; The rules and regulations for the Certification of Inspectors of Buildings, Building Commissioners and Local Inspectors shall be as set forth in 780 CMR R7.

108.4 Enforcement: Whoever violates the provisions of 780 CMR 108.0 or any rules and regulations promulgated hereunder, or who falsifies or counterfeits a license, registration or certification issued by the BBRS, or who fraudulently issues or accepts such a license, registration or certification shall be punished as provided in 780 CMR 118.0 or shall be subject to any other penalty provided for by law.

NON-TEXT PAGE

780 CMR 109.0 APPROVAL

109.1 Approved materials and equipment: All materials, equipment and devices approved by the building official shall be constructed and installed in accordance with such approval.

109.2 Used materials and equipment: Used materials, equipment and devices which meet the minimum requirements of 780 CMR for new materials, equipment and devices shall be permitted; however, the building official may require satisfactory proof that such materials, equipment and devices have been reconditioned, tested, and/or placed in good and proper working condition prior to approval.

109.3 Alternative materials and equipment:

109.3.1 General: The provisions of 780 CMR are not intended to limit the appropriate use or installation of materials, appliances, equipment or methods of design or construction not specifically prescribed by 780 CMR, provided that any such alternative has been approved. Alternative materials, appliances, equipment or methods of design or construction shall be approved when the building official is provided acceptable proof and has determined that said alternative is satisfactory and complies with the intent of the provisions of 780 CMR, and that said alternative is, for the purpose intended, at least the equivalent of that prescribed in 780 CMR in quality, strength, effectiveness, *fire resistance*, durability and safety. Compliance with specific performance based provisions of 780 CMR, in lieu of a prescriptive requirement shall also be permitted as an alternate.

109.3.2 Evidence submitted: The building official may require that evidence or proof be submitted to substantiate any claims that may be made regarding the proposed alternate.

109.3.3 Tests: Determination of acceptance shall be based on design or test methods or other such standards approved by the BBRS. In the alternative, where the BBRS has not provided specific approvals, the building official may accept, as supporting data to assist in this determination, duly authenticated engineering reports, formal reports from nationally acknowledged testing/ listing laboratories, reports from other accredited sources. The costs of all tests, reports and investigations required under these provisions shall be borne by the applicant.

109.3.4 Approval by the Construction Materials Safety Board: The building official may refer such matters to the Construction Materials Safety Board in accordance with 780 CMR 123.0 for approval.

780 CMR 110.0 APPLICATION FOR PERMIT

110.1 Permit application: It shall be unlawful to construct, reconstruct, alter, repair, remove or demolish a *building* or *structure*; or to change the use or *occupancy* of a *building* or *structure*; or to install or alter any equipment for which provision is made or the installation of which is regulated by 780 CMR without first filing a written application with the building official and obtaining the required permit therefor.

110.2 Temporary Structures:

110.2.1 General: A building permit shall be required for temporary structures, unless exempted by 780 CMR 110.3. Such permits shall be limited as to time of service, but such temporary construction shall not be permitted for more than one year.

110.2.2 Special approval: All temporary construction shall conform to the structural strength, fire safety, *means of egress*, light, ventilation, energy conservation and sanitary requirements of 780 CMR as necessary to insure the public health, safety and general welfare.

110.2.3 Termination of approval: The building official may terminate such special approval and order the demolition of any such construction at the discretion of the building official.

110.3 Exemptions: A building permit is not required for the following activities, such exemption, however, shall not exempt the activity from any review or permit which may be required pursuant to other laws, by-laws, rules and regulations of other jurisdictions (e.g. zoning, conservation, etc.).

1. One *story* detached accessory buildings used as tool or storage sheds, playhouses and similar uses, provided the floor area does not exceed 120 square feet.
2. Fences six feet in height or less.
3. *Retaining walls* which, in the opinion of the building official, are not a threat to the public safety health or welfare and which retain less than four feet of unbalanced fill.
4. Ordinary repairs as defined in 780 CMR 2. Ordinary repairs shall not include the cutting away of any wall, partition or portion thereof, the removal or cutting of any structural beam, column or other loadbearing support, or the removal or change of any required *means of egress*, or rearrangement of parts of a structure affecting the egress requirements; nor shall ordinary repairs include addition to, alteration of, replacement or relocation of any standpipe, water supply, mechanical system, *fire protection system*, energy conservation system or other work affecting public health or general safety.

Note: Also see 780 CMR 903.1 (Exceptions 1. and 2.).

5. Greenhouses: A building permit or notice to the building official is not required for the construction of greenhouses covered exclusively with plastic film (in accordance with St. 1983, c. 671). (This exemption does not apply if the greenhouse is to be used for large assemblies of people or uses other than normally expected for this purpose.)

110.4 Form of application: The application for a permit shall be submitted in such form as determined by the building official but in all cases shall contain, as a minimum, the information required on the appropriate sample uniform building permit application forms in *Appendix B*. The application for a permit shall be accompanied by the required fee as prescribed in 780 CMR 114.0 and the construction documents as required in 780 CMR 110.7 and 110.8, where applicable and as required by other sections of 780 CMR.

110.5 By whom application is made: Application for a permit shall be made by the owner or lessee of the *building* or *structure*, or agent of either. If application is made other than by the owner, the written authorization of the owner shall accompany the application. Such written authorization shall be signed by the owner and shall include a statement of ownership and shall identify the owner's authorized agent, or shall grant permission to the lessee to apply for the permit. The full names and addresses of the owner, lessee, applicant and the responsible officers, if the owner or lessee is a corporate body, shall be stated in the application.

Note: It shall be the responsibility of the registered contractor to obtain all permits necessary for work covered by the Home Improvement Contractor Registration Law, M.G.L. c. 142A. An owner who secures his or her own permits for such shall be excluded from the guaranty fund provisions as defined in M.G.L. c. 142A. Refer to 780 CMR R6 and M.G.L. c. 142A for additional information regarding the Home Improvement Contractor Registration Program.

110.6 The securing of a building permit by the owner, or the owner's authorized agent, to construct, reconstruct, alter, repair, demolish, remove, install equipment or change the use or *occupancy* of a *building* or *structure*, shall not be construed to relieve or otherwise limit the duties and responsibilities of the licensed, registered or certified individual or firm under the rules and regulations governing the issuance of such license registration or certification.

110.7 Construction documents: The application for permit shall be accompanied by not less than three sets of *construction documents*. The building official is permitted to waive, or modify the requirements for filing construction documents when the building official determines that the scope of the work is of a minor nature. When the quality of the materials is essential for conformity to 780 CMR, specific information shall be given to establish such quality, and 780 CMR shall not be cited, or the term "legal" or its equivalent used as a substitute for specific information.

110.8 Engineering Details, Reports, Calculations, Plans and Specifications: In the application for a permit for *buildings* and *structures* subject to construction control in 780 CMR 116.0, the *construction documents* shall contain sufficient plans and details to fully describe the work intended, including, but not limited to all details sufficient to describe the structural, *fire protection*, fire alarm, mechanical, light and ventilation, energy conservation, architectural access and egress systems. The building official may require such calculations, descriptions narratives and reports deemed necessary to fully describe the basis of design for each system regulated by 780 CMR. In accordance with the provisions of M.G.L. c. 143, § 54A all plans and specifications shall bear the original seal and original signature of a Massachusetts registered professional engineer or registered architect responsible for the design, except as provided in M.G.L. c. 143, § 54A and any profession or trade as provided in M.G.L. c. 112, § 60L and M.G.L. c. 112, § 81R.

When such application for permit must comply with the provisions of 780 CMR 4 or 780 CMR 9 or 780 CMR 34, the building official shall cause one set of construction documents filed pursuant to 780 CMR 110.7 to be transmitted simultaneously to the head of the local fire department for his file, review and approval of the items specified in 780 CMR 903.0 as they relate to the applicable sections of 780 CMR 4, 780 CMR 9 or 780 CMR 34. The head of the local fire department shall within ten working days from the date of receipt by him, approve or disapprove such construction documents. If the head of the local fire department disapproves such construction documents, he or she shall do so, in writing citing the relevant sections of noncompliance with 780 CMR or the sections of the referenced standards of *Appendix A*. Upon the request of the head of the local fire department, the building official may grant one or more extensions of time for such review provided, however, that the total review by said head of the local fire department shall not exceed 30 Calendar days. If such approval, disapproval or request for extension of time is not received by the building official within said ten working days, the building official may deem the construction documents to be in full compliance with the applicable sections of 780 CMR 4, 780 CMR 9 or 780 CMR 34 and, therefore approved by the head of the local fire department.

110.9 Existing Buildings: The application for a building permit to reconstruct, alter or change the use or *occupancy* of *existing buildings* or *structures* which are subject to construction control pursuant to 780 CMR 116.0, shall be accompanied by a building survey where required by 780 CMR 34 and *Appendix F*.

110.10 Site plan: A site plan shall be filed showing, to scale, the size and location of all new construction and all *existing structures* on the site, distances from *lot lines*, the established street grades and the proposed finished grades; and it shall be drawn in accordance with an accurate boundary line survey. In the case of demolition, the site plan shall show all construction to be demolished and the location and size of all *existing structures* and construction that are to remain on the site or plot.

110.11 Independent Structural Engineering Review:

110.11.1 As a condition for the issuance of a building permit, the structural design of the following described structures shall be reviewed by an independent structural engineer to verify that the design of the primary structure is conceptually correct and that there are no major errors in the design:

1. Buildings which are five stories or more in *height* above the lowest floor, including stories below grade.
2. Buildings which enclose a total volume of 400,000 cubic feet, including stories below grade. The volume shall be measured using the outside dimensions of the *building*.
3. Structures in *Use Group* A, or structures which are partially in *Use Group* A, which will be used for public assembly of 300 or more persons.
4. Structures of unusual complexity or design shall be determined by the BBRS. A building official may apply to the BBRS for such a determination on a specific structure.

Exemption:Temporary structures erected for a period of one year or less.

110.11.2 Requirements for the review: The independent structural engineering review shall be in accordance with the requirements of *Appendix I*.

110.11.3 Disputes between the structural engineer responsible for the design of the *building* or *structure* and the structural engineering peer shall be resolved by the structural peer review advisory committee in accordance with 780 CMR 125.0.

110.12 Structures subject to control: In those structures subject to control as required in 780 CMR 116.0, affidavits must be submitted with the permit application that the individuals and testing laboratories responsible for carrying out the duties specified in 780 CMR 116.0 have been licensed by the BBRS.

110.13 Amendments to application: Subject to the limitations of 780 CMR 110.14, amendments to a plan, application or other records accompanying the same shall be filed prior to the commencement of the work for which the amendment to the permit is sought or issued. Such amendments shall be deemed part of the original application and shall be submitted in accordance with 780 CMR 110.0.

110.14 Time limitation of application: An application for a permit for any proposed work shall be deemed to have been abandoned six months after the date of filing, unless such application has been diligently prosecuted or a permit shall have been issued; except that the building official shall grant one or more extensions of time for additional periods not exceeding 90 days each if there is reasonable cause and upon written request by the owner.

780 CMR 111.0 PERMITS

111.1 Action on application: The building official shall examine or cause to be examined all applications for permits and amendments thereto within 30 days after filing thereof. If the application or the construction documents do not conform to the requirements of 780 CMR and all pertinent laws under the building official's jurisdiction, the building official shall reject such application in writing, stating the reasons therefor. If the building official is satisfied that the proposed work conforms to the requirements of 780 CMR and all laws and ordinances applicable thereto, the building official shall issue a permit therefor.

111.2 Zoning: In accordance with the provisions of M.G.L. c. 40A or St. 1956, c. 665 as amended, no permit for the construction, alteration, change of use or moving of any *building* or *structure* shall be issued if such *building* or *structure* or use would be in violation of any zoning ordinance or by-law.

111.3 Railroad right-of-way: No permit to build a *structure* of any kind on land formerly used as a railroad right-of-way or any property appurtenant thereto formerly used by any railroad company in the state shall be issued without first obtaining, after public hearing, the consent in writing to the issuance of such permit from the Secretary of the Executive Office of Transportation and Construction, all in accordance with M.G.L. c. 40, § 54A.

111.4 Water Supply: No permit shall be issued for the construction of a *building* or *structure* which would necessitate the use of water therein, unless a supply of water is available therefor, either from a water system operated by a city, town or district, or from a well located on the land where the *building* or *structure* is to be constructed, or from a water corporation or company, as required by M.G.L. c. 40, § 54.

111.5 Debris: As a condition of issuing a permit for the demolition, renovation, rehabilitation or other alteration of a *building* or *structure*, M.G.L. c. 40, § 54 requires that the debris resulting therefrom shall be disposed of in a properly licensed solid waste disposal facility as defined by M.G.L. c. 111, § 150A. Signature of the permit applicant, date and number of the building permit to be issued shall be indicated on a form provided by the building department, and attached to the office copy of the building permit retained by the building department. If the debris will not be disposed of as indicated, the holder of the permit shall notify the building official, in writing, as to the location where the debris will be disposed.

111.6 Workers' Compensation: No permit shall be issued to construct, reconstruct, alter or demolish a *building* or *structure* until acceptable proof of insurance pursuant to M.G.L. c. 152, § 25C(6) has been provided to the building official.

111.7 Hazards to air navigation: Application for building new structures or adding to existing structures within airport approaches as defined in M.G.L. c. 90, §35B and any amendments thereto or language substituted therefor, must include a certification by the applicant that;

1. Either a permit from the Massachusetts Aeronautics Commission is not required because the structure is, or will be; a) In an area subject to airport approach regulations adopted pursuant to M.G.L. c. 90, §§ 40A through 40I, or; b) in an approach to Logan International Airport, or; c) less than 30 feet above ground level, or;
2. A permit from the Massachusetts Aeronautics Commission is required pursuant to M.G.L. c. 90, § 35B and a copy of said permit is enclosed with the application.

Applications for permits to build a new structure or add to an existing structure requiring the filing of a Notice of Proposed Construction or Alteration (FAA Form 7460-1) with the Federal Aviation Commission shall mail a copy of the completed FAA Form 7460-1 to the Massachusetts Aeronautic Commission within three business days after submitting said form to the FAA.

111.8 Expiration of permit: Any permit issued shall be deemed abandoned and invalid unless the work authorized by it shall have been commenced within six months after its issuance; however, for cause, and upon written request of the owner, one or more extensions of time, for periods not exceeding six months each, may be granted in writing by the building commissioner or inspector of buildings. Work under such a permit in the opinion of the building commissioner or inspector of buildings, must proceed in good faith continuously to completion so far as is reasonably practicable under the circumstances. It is the sole responsibility of the owner to inform, in writing, the building commissioner or inspector of buildings of any facts which support an extension of time. The building commissioner or inspector of buildings has no obligation under 780 CMR 111.7 to seek out information which may support an extension of time. The owner may not satisfy this requirement by informing any other municipal and/or state official or department.

For purposes of 780 CMR 111.7 any permit issued shall not be considered invalid if such abandonment or suspension of work is due to a court order prohibiting such work as authorized by such permit; provided, however, in the opinion of the building commissioner or inspector of buildings, the person so prohibited by such court order, adequately defends such action before the court.

111.9 Previous approvals: 780 CMR shall not require changes in the construction documents, construction or designated *use group* of a *building* for which a lawful permit has been heretofore issued or otherwise lawfully authorized, and the construction of which has been actively prosecuted within 180 days after the effective date of 780 CMR and is completed with dispatch.

111.10 Signature to permit: The building official's signature shall be attached to every permit; or the building official shall authorize a subordinate to affix such signature thereto.

111.11 Approved construction documents: When the building official has determined that the proposed construction conforms to the provisions of 780 CMR and other applicable laws, by-laws, rules and regulations under his/her jurisdiction, the building official shall stamp or endorse in writing the three sets of construction documents "Approved". One set of the approved construction documents shall be retained by the building official, one set by the head of the local fire department and the other set shall be kept at the construction site, open to inspection of the building official or an authorized representative at all reasonable times.

111.12 Revocation of permits: The building official shall revoke a permit or approval issued under the provisions of 780 CMR in case of any false statement or misrepresentation of fact in the application or on the plans on which the permit or approval was based.

111.13 Approval in part: The building official may issue a permit for the construction of foundations or any other part of a *building* or *structure* before the construction documents for the whole *building* or *structure* have been submitted, provided that adequate information and detailed statements have been filed complying with all of the pertinent requirements of 780 CMR. Work shall be limited to that work approved by the partial approval and further work shall proceed only when the building permit is amended in accordance with 780 CMR 110.13. The holder of such permit for the foundation or other parts of a *building* or *structure* shall proceed at the holder's own risk with the building operation and without assurance that a permit for the entire *building* or *structure* will be granted.

111.14 Posting of permit: A true copy of the building permit shall be kept on the site of operations, open to public inspection during the entire time of prosecution of the work and until the completion of the same.

111.15 Notice of start: At least 24-hour notice of start of work under a building permit shall be given to the building official.

780 CMR 112.0 DEMOLITION OF STRUCTURES

112.1 Service connections: Before a *building* or *structure* is demolished or removed, the owner or agent shall notify all utilities having service connections within the *structure* such as water, electric, gas, sewer and other connections. A permit to demolish or remove a *building* or *structure* shall not be issued until a release is obtained from the utilities, stating that their respective service connections and appurtenant equipment, such as meters and regulators, have been removed or sealed and plugged in a safe manner.

All debris shall be disposed of in accordance with 780 CMR 111.5.

112.2 Notice to adjoining owners: Only when written notice has been given by the applicant to the owners of adjoining *lots* and to the owners of wired or other facilities, of which the temporary removal is necessitated by the proposed work, shall a permit be granted for the removal of a *building* or *structure*.

112.3 Lot regulation: Whenever a *building* or *structure* is demolished or removed, the *premises* shall be maintained free from all unsafe or hazardous conditions by the proper regulation of the *lot*, restoration of established grades and the erection of the necessary *retaining walls* and fences in accordance with the provisions of 780 CMR 33.

780 CMR 113.0 CONDITIONS OF PERMIT

113.1 Payment of fees: A permit shall not be issued until the fees prescribed in 780 CMR 114.0 have been paid.

113.2 Compliance with code: The permit shall be a license to proceed with the work and shall not be construed as authority to violate, cancel or set aside any of the provisions of 780 CMR or any other law or regulation, except as specifically stipulated by modification or legally granted variation as described in the application.

113.3 Compliance with permit: All work shall conform to the approved application and the approved construction documents for which the permit has been issued and any approved amendments to the approved application or the approved construction documents.

113.4 Compliance with site plan: All new work shall be located strictly in accordance with the approved site plan.

780 CMR 114.0 FEES

114.1 General: A permit to begin work for new construction, alteration, removal, demolition or other building operation shall not be issued until the fees prescribed in 780 CMR 114.0 shall have been paid to the department of building inspection or other authorized agency of the jurisdiction, nor shall an amendment to a permit necessitating an additional fee be approved until the additional fee has been paid.

114.2 Special fees: The payment of the fee for the construction, alteration, removal or demolition for all work done in connection with or concurrently with the work contemplated by a building permit shall not relieve the applicant or holder of the permit from the payment of other fees that are prescribed by law or ordinance for water taps, sewer connections, electrical permits, erection of *signs* and display structures, *marquees* or other *appurtenant structures*, or fees of inspections, certificates of *occupancy* or other privileges or requirements, both within and without the jurisdiction of the department of building inspection.

114.3 New construction and alterations: The fees for plan examination, building permit and inspections shall be as prescribed in 780 CMR 114.3.1 and the building official is authorized to establish by approved rules a schedule of unit rates for *buildings* and *structures* of all *use groups* and types of construction as classified and defined in 780 CMR l, 3 and 6.

114.3.1 Fee schedule: A fee for each plan examination, building permit and inspection shall be paid in accordance with the fee schedule as established by the municipality.

114.4 Accounting: The building official shall keep an accurate account of all fees collected; and such collected fees shall be deposited in the jurisdiction treasury in accordance with procedures established by the municipality, or otherwise disposed of as required by law.

780 CMR 115.0 INSPECTION

115.1 Preliminary inspection: Before issuing a permit, the building official shall, if deemed necessary, examine or cause to be examined all *buildings*, *structures* and sites for which an application has been filed for a permit to construct, enlarge, alter, repair, remove, demolish or change the use or *occupancy* thereof.

115.2 Required inspections: After issuing a building permit, the building official shall conduct inspections during construction at intervals sufficient to ensure compliance with the provisions of 780 CMR. The building official shall inform the applicant of the required points of inspection at the time of application. Upon completion of the work for which a permit has been issued, the building official shall conduct a final inspection pursuant to 780 CMR 115.5. A record of all such examinations and inspections and of all violations of 780 CMR shall be maintained by the building official. For *buildings* and *structures* subject to construction control, the owner shall provide for special inspections in accordance with 780 CMR 1705.0.

In conjunction with specific construction projects, the building official may designate specific inspection points in the course of construction that require the contractor or builder to give the building official 24 hours notice prior to the time when those inspections need to be performed. The building official shall make the inspections within 48 hours after notification.

115.3 Approved inspection agencies: The building official may accept reports of approved inspection agencies provided such agencies satisfy the requirements as to qualifications and reliability.

115.4 Plant inspection: Where required by the provisions of 780 CMR or by the approved rules, materials or assemblies shall be inspected at the point of manufacture or fabrication in accordance with 780 CMR 1703.3.

115.5 Final inspection: Upon completion of the *building* or *structure*, and before issuance of the certificate of *occupancy* required by 780 CMR 120.0, a final inspection shall be made. All variations of the approved construction documents and permit shall be noted and the holder of the permit shall be notified of the discrepancies.

115.6 General: In the discharge of his duties, the building official shall have the authority to enter at any reasonable hour any *building*, *structure* or *premises* in the municipality to enforce the provisions of 780 CMR.

If any owner, occupant, or other person refuses, impedes, inhibits, interferes with, restricts, or obstructs entry and free access to every part of the *structure*, operation or *premises* where inspection authorized by 780 CMR is sought. the building official, or state inspector may seek, in a court of competent jurisdiction, a search warrant so as to apprise the owner, occupant or other person concerning the nature of the inspection and justification for it and may seek the assistance of police authorities in presenting said warrant.

115.7 Identification: The building official shall carry proper identification when inspecting *structures* or *premises* in the performance of duties under 780 CMR.

115.8 Jurisdictional cooperation: The assistance and cooperation of police, fire, and health departments and all other officials shall be available to the building official as required in the performance of his duties.

115.9 Coordination of inspections: Whenever in the enforcement of 780 CMR or another code or ordinance, the responsibility of more than one building official of the jurisdiction is involved, it shall be the duty of the building officials involved to coordinate their inspections and administrative orders as fully as practicable so that the owners and occupants of the *building* or *structure* shall not be subjected to visits by numerous inspectors or multiple or conflicting orders. Whenever an inspector from any agency or department observes an apparent or actual violation of some provision of some law, ordinance or code not within the inspector's authority to enforce, the inspector shall report the findings to the building official having jurisdiction.

780 CMR 116.0 REGISTERED ARCHITECTURAL AND PROFESSIONAL ENGINEERING SERVICES - CONSTRUCTION CONTROL

116.1 General: The provisions of 780 CMR 116.0 define the construction controls required for all *buildings* and *structures* needing registered architectural or registered professional engineering services, and delineate the responsibilities of such professional services together with those services that are the responsibility of the contractor during construction.

The following structures are exempt from the requirements of 780 CMR 116.0;

1. Any *building* containing less than 35,000 cubic feet of enclosed space, measured to the exterior surfaces of walls and *roofs* and to the top of a ground supported floor, or in the case of a crawl space, to the bottom surface of the crawl space. In the case of basement floors or levels, the calculation of enclosed space shall include such spaces.
2. Any single or two family dwelling or any accessory *building* thereto;
3. Any *building* used exclusively for farm purposes (this exemption does not apply if the building is to be used for large assemblies of people or uses other than farm purposes); and
4. *Retaining walls* less than ten feet in *height* at all points along the wall as measured from the base of the footing to the top of the wall.

Notwithstanding the exemptions above, professional engineering services shall be required for activities which are deemed to constitute the practice of engineering as defined in M.G.L. c. 112, § 81D, except as provided in M.G.L. c. 54A and any legally required profession or as provided in M.G.L. c. 112, § 81R.

116.1.1 Specialized structures requiring construction control: Telecommunication towers and similar structures are engineered structures and shall be subject to the requirements of 780 CMR 116.

116.2 Registered architectural and engineering services:

116.2.1 Design: All plans, computations and specifications involving new construction, alterations, repairs, expansions or additions or change in use or *occupancy* of *existing buildings* shall be prepared by or under the direct supervision of a Massachusetts registered architect or Massachusetts registered professional engineer and shall bear his or her original signature and seal or by the legally recognized professional performing the work, as defined by M.G.L. c. 112, §81R. Said signature and seal shall signify that the plans, computations and specifications meet the applicable provisions of 780 CMR and all accepted engineering practices.

116.2.2 Architect/engineer responsibilities during construction: The registered architects and registered professional engineers who have prepared plans, computations and specifications or the registered architects or registered professional engineers who have been retained to perform construction phase services, shall perform the following tasks for the portion of the work for which they are directly responsible;

1. Review, for conformance to the design concept, shop drawings, samples and other submittals which are submitted by the contractor in accordance with the requirements of the construction documents.
2. Review and approval of the quality control procedures for all code-required controlled materials.
3. Be present at intervals appropriate to the stage of construction to become, generally familiar with the progress and quality of the work and to determine, in general, if the work is being performed in a manner consistent with the construction documents.

116.2.3 Structural Tests and Inspections: Structural tests and inspection shall be provided in accordance with 780 CMR 1705.0.

116.2.4 Tests and Inspections of non structural systems: Tests and inspections of non structural systems shall be performed in accordance with applicable engineering practice standards or referenced standards listed in *Appendix A*.

116.3 Construction contractor services: The actual construction of the work shall be the responsibility of the general contractor as identified on the approved building permit and shall involve the following:

1. Execution of all work in accordance with the approved construction documents.
2. Execution and control of all methods of construction in a safe and satisfactory manner in accordance with all applicable local, state, and federal statutes and regulations.
3. Upon completion of the construction, he shall certify to the best of his knowledge and belief that such has been done in substantial accord with 780 CMR 116.3 items 1 and 2 and with all pertinent deviations specifically noted.

116.4 On site project representation: When applications for unusual designs or magnitude of construction are filed, or where reference standards require special architectural or engineering inspections, the building official may require full-time project representation by a registered architect or professional engineer in addition to that provided in 780 CMR 116.2.2. The project representative shall keep daily records and submit reports as may be required by the building official. Upon completion of the work, the registered architect or professional engineer shall file a final report indicating that the work has been performed in accordance with the approved plans and 780 CMR.

116.4.1 Building permit requirement: This on-site project representation requirement shall be determined prior to the issuance of the building permit and shall be a requisite for the permit issuance. Refusal by the applicant to provide such service as required by the building official shall result in the denial of the permit. However, the applicant may file an appeal as provided in 780 CMR 122.0.

116.4.2 Fee and costs: All fees and costs related to the performance of on-site project representation shall be borne by the owner.

116.5 Building official responsibility: Nothing contained in 780 CMR 116.0 shall have the effect of waiving or limiting the building official's authority to enforce 780 CMR with respect to examination of the contract documents, including plans, computations and specifications, and field inspections (see 780 CMR 106.0).

780 CMR 117.0 WORKMANSHIP

117.1 General: All work shall be conducted, installed and completed in a workmanlike and acceptable manner so as to secure the results intended by 780 CMR.

780 CMR 118.0 VIOLATIONS

118.1 Unlawful acts: It shall be unlawful for any person, firm or corporation to use, occupy or change the use or *occupancy* of any *building* or *structure* or to erect, construct, alter, extend, repair, remove, demolish any *building* or *structure* or any equipment regulated by 780 CMR, or cause same to be done, in conflict with or in violation of any of the provisions of 780 CMR.

118.2 Notice of violation: The building official shall serve a notice of violation or order on the person responsible for the erection, construction, alteration, extension, repair, removal, demolition or *occupancy* of a *building* or *structure* in violation of the provisions of 780 CMR, or in violation of a detail statement or a plan approved thereunder, or in violation of a permit or certificate issued under the provisions of 780 CMR. Such order shall be in writing and shall direct the discontinuance of the illegal action or condition and the abatement of the violation.

118.3 Prosecution of violation: If the notice of violation is not complied with in the time period specified in said notice of violation, the building official may institute the appropriate proceedings at law or in equity to restrain, correct or abate such violation or to require the removal or termination of the unlawful *occupancy* of the *building* or *structure* in violation of the provisions of 780 CMR or of the order or direction made pursuant thereto.

118.4 Violation penalties: Whoever violates any provision of 780 CMR, except any specialized code referenced herein, shall be punishable by a fine of not more than $1,000 or by imprisonment for not more than one year, or both for each such violation. Each day during which a violation exists shall constitute a separate offense. The building official shall not begin criminal prosecution for such violations until the lapse of 30 days after the issuance of the written notice of violation.

118.5 Abatement of violation: The imposition of the penalties herein prescribed shall not preclude the legal officer of the jurisdiction from instituting appropriate action to prevent unlawful construction or to restrain, correct or abate a violation, or to prevent illegal *occupancy* of a *building*, *structure* or *premises* or to stop an illegal act, conduct, business or *occupancy* of a *building* or *structure* on or about any *premises*.

118.6 Notice or orders, service and content: Every notice or order authorized by 780 CMR shall be in writing and shall be served on the person responsible:

1. personally, by any person authorized by the building official; or
2. by any person authorized to serve civil process by leaving a copy of the order or notice at the responsible party's last and usual place of abode; or
3. by sending the party responsibile a copy of the order by registered or certified mail return receipt requested, if he is within the Commonwealth; or
4. if the responsibile party's last and usual place of abode is unknown, by posting a copy of this order or notice in a conspicuous place on or about the *premises* in violation and by publishing it for at least three out of five consecutive days in one or more newspapers of general circulation wherein the *building* or *premises* affected is situated.

780 CMR 119.0 STOP WORK ORDER

119.1 Notice to owner: Upon notice from the building official that work on any *building* or *structure* is being prosecuted contrary to the provisions of 780 CMR or in an unsafe and dangerous manner or contrary to the approved construction documents submitted in support of the building permit application, such work shall be immediately stopped. The stop work order shall be in writing and shall be given to the owner of the property involved, or to the owner's agent, or to the person doing the work; and shall state the conditions under which work will be permitted to resume.

119.2 Unlawful continuance: Any person who shall continue any work in or about the *building* or *structure* after having been served with a stop work order, except such work as that person is directed to perform to remove a violation or unsafe condition, shall be liable to a fine of not more than $1,000 or by imprisonment for not more than one year, or both for each such violation. Each day during which a violation exists shall constitute a separate offense.

780 CMR 120.0 CERTIFICATE OF OCCUPANCY

120.1 General: New buildings and structures: A *building* or *structure* hereafter shall not be used or occupied in whole or in part until the certificate of use and *occupancy* shall have been issued by the building commissioner or inspector of buildings or, when applicable, the state inspector. The certificate shall not be issued until all the work has been completed in accordance with the provisions of the approved permits and of the applicable codes for which a permit is required, except as provided in 780 CMR 120.3.

120.2 Buildings or structures hereafter altered: A *building* or *structure*, in whole or in part, altered to change from one *use group* to another; to a different use within the same *use group*; the fire grading; the maximum live load capacity; the *occupancy* load capacity shall not be occupied or used until the certificate shall have been issued certifying that the work has been completed in accordance with the provisions of the approved permits and of the applicable codes for which a permit is required. Any use or *occupancy*, which was not discontinued during the work of alteration, shall be discontinued within 30 days after the completion of the alteration unless the required certificate is issued.

120.3 Temporary occupancy: Upon the request of the holder of a permit, a temporary certificate of *occupancy* may be issued before the completion of the entire work covered by the permit, provided that such portion or portions shall be occupied safely prior to full completion of the *building* or *structure* without endangering life or public welfare. Any *occupancy* permitted to continue during the work shall be discontinued within 30 days after completion of the work unless a certificate of *occupancy* is issued by the building official.

120.4 Contents of certificate: When a *building* or *structure* is entitled thereto, the building official shall issue a certificate of *occupancy* within ten days after written application. Upon completion of the final inspection in accordance with 780 CMR 115.5 and correction of the violations and discrepancies, and compliance with 780 CMR 903.4, the certificate of *occupancy* shall be issued. The certificate of *occupancy* shall specify the following.

1. The edition of the code under which the permit was issued.
2. The *use group* and *occupancy*, in accordance with the provisions of 780 CMR 3.
3. The type of construction as defined in 780 CMR 6.
4. The occupant load per floor.
5. Any special stipulations and conditions of the building permit.

120.5 Posting structures:

120.5.1 Posted use and occupancy: A suitably designed placard approved by the building official shall be posted by the owner on all floors of every building and structure and part thereof designed for high hazard, storage, mercantile, factory and industrial or business use (use groups H, S, M, F and B) as defined in 780 CMR 3. Said placard shall be securely fastened to the building or structure in a readily visible place, stating: the use group, the fire grading, the live load and the occupancy load.

120.5.2 Posted occupancy load: A suitably designed placard approved by the building official shall be posted by the owner in every room where practicable of every building and structure and part thereof designed for use as a place of public assembly or as an institutional building for harboring people for penal, correctional, educational, medical or other care or treatment, or as residential buildings used for hotels, lodging houses, boarding houses, dormitory buildings, multiple family dwellings (use groups A, I, R-1 and R-2). Said placard shall designate the maximum occupancy load.

120.5.3 Replacement of posted signs: All posting signs shall be furnished by the owner and shall be of permanent design; they shall not be removed or defaced, and if lost, removed or defaced, shall be immediately replaced.

120.5.4 Periodic inspection for posting: The building official may periodically inspect all existing buildings and structures except one and two family dwellings for compliance with 780 CMR in respect to posting; or he may accept the report of such inspections from a qualified registered engineer or architect or others certified by the BBRS; and such inspections and reports shall specify any violation of the requirements of 780 CMR in respect to the posting of floor load, fire grading, occupancy load and use group of the building or structure.

780 CMR 121.0 UNSAFE STRUCTURES

121.1 General: The provisions of 780 CMR 121.0 are established by M.G.L. c. 143, §§ 6, 7, 8, 9 and 10.

121.2 Inspection: The building official immediately upon being informed by report or otherwise that a *building* or other *structure* or anything attached thereto or connected therewith is dangerous to life or limb or that any *building* in that city or town is unused, uninhabited or abandoned, and open to the weather, shall inspect the same; and he shall forthwith in writing notify the owner to remove it or make it safe if it appears to him to be dangerous, or to make it secure if it is unused, uninhabited or abandoned and open to the weather.

If it appears that such *building* or *structure* would be especially unsafe in case of fire, it shall be deemed dangerous within the meaning hereof, and the building official may affix in a conspicuous place upon its exterior walls a notice of its dangerous condition, which shall not be removed or defaced without authority from him.

121.3 Removal or making structure safe: Any person so notified shall be allowed until 12:00 noon of the day following the service of the notice in which to begin to remove such *building* or *structure* or make it safe, or to make it secure, and he shall employ sufficient labor speedily to make it safe or remove it or to make it secure; but if the public safety so requires and if the mayor or selectmen so order, the building official may immediately enter upon the *premises* with the necessary workmen and assistants and cause such unsafe structure to be made safe or demolished without delay and a proper fence put up for the protection of passersby, or to be made secure.

121.4 Failure to remove or make structure safe, survey board, survey report: If an owner of such unsafe structure refuses or neglects to comply with the requirements of such notice within the specified time limit, and such *structure* is not made safe or taken down as ordered therein, a careful survey of the *premises* shall be made by a board consisting; in a city, of a city engineer, the head of the fire department, as such term is defined in M.G.L. c. 148, § 1, and one disinterested person to be appointed by the building official; and, in a town of a surveyor, the head of the fire department and one disinterested person to be appointed by the building official. In the absence of any of the above officers or individuals, the mayor or selectmen shall designate one or more officers or other suitable persons in place of the officers so named as members of said board. A written report of such survey shall be made, and a copy thereof served on such owner.

121.5 Removal of dangerous or abandoned structures: If such survey report as outlined in 780 CMR 121.4 declares such *structure* to be dangerous or to be unused, uninhabited or abandoned, and open to the weather, and if the owner continues such refusal or neglect, the building official shall cause it to be made safe or taken down or to be made secure; and, if the public safety so requires, said building official may at once enter the *structure*, the land on which it stands or the abutting land or *buildings*, with such assistance as he may require, and secure the same; and may remove and evict, under the pertinent provisions of M.G.L. c. 239, or otherwise, any tenant or occupant thereof; and may erect such protection for the public by proper fence or otherwise as may be necessary, and for this purpose may close a public highway. In the case of such demolition, the said building official shall cause such *lot* to be leveled to conform with adjacent grades by a inorganic fill. The costs and charges incurred shall constitute a lien upon the land upon which the *structure* is located, and shall be enforced in an action of contract; and such owner shall, for every day's continuance of such refusal or neglect after being so notified, be punished by a fine in accordance with 780 CMR 118.4. The provisions of M.G.L. c. 139, § 3A, paragraph two, relative to liens for such debt and the collection of claims for such debt shall apply to any debt referred to in this section, except that the said building official shall act hereunder in place of the mayor or board of selectmen. During the time such order is in effect, it shall be unlawful to use or occupy such *structure* or any portion thereof for any purpose.

121.6 Remedy of person ordered to remove a dangerous structure or make it safe: Notwithstanding the provisions of 780 CMR 122, an owner, aggrieved by such order may have the remedy prescribed by M.G.L. c. 139, § 2: provided that any provision of M.G.L. c. 139, § 2 shall not be construed so as to hinder, delay or prevent the building official from acting and proceeding under 780 CMR 121; and provided, further, that this section shall not prevent the city or town from recovering the forfeiture provided in said 780 CMR 121.5 from the date of the service of the original notice, unless the order is annulled by the jury.

121.7 Standards for making buildings safe or secure: Any owner of a building who has been notified that said building shall be made safe or secure under 780 CMR 121.2, shall:

1. Remove all materials determined by the head of the fire department or building official to be dangerous in case of fire.
2. Secure all floors accessible from grade utilizing one of the following methods so long as such method is approved by the head of the fire department and building official in writing:
    a. Secure all window and door openings in accordance with the U.S. Fire Administration, National Arson Prevention Initiative Board Up Procedures, continuously until such time as the building is reoccupied; or
    b. Provide 24 hour watchman services, continuously until such time as the building is reoccupied; or
    c. Provide a monitored intruder alarm system at the perimeter of all floors accessible from grade, continuously until such time as the building is reoccupied.

Said owner, as the case may be, shall notify the building official that the approved method chosen to secure the building has been incorporated. Said owner shall allow the building official to enter the building for an inspection to ascertain that the building is secured and made safe. Said owner shall allow the head of the fire department to enter the building. The building official shall be supplied with records of maintenance and operation if the provisions of 780 CMR 121.7.2.b or c. are used.

3. Maintain any existing fire alarms or sprinkler systems unless written permission is obtained from the head of the fire department in accordance with M.G.L. c. 148, § 27A to shut off or disconnect said alarms or systems.

4. Maintain utilities unless written permission is obtained from the building official to disconnect said utilities. Permission to disconnect utilities shall not be granted if it will result in inadequate heat to prevent freezing of an automatic sprinkler system or inadequate utilities to maintain any other protection systems.

5. The requirements of 780 CMR 121.7.1. through 4. do not prevent a building official from ordering or taking expeditious, temporary security measures in *emergency situations* pending the completion of the requirements of 780 CMR 121.7.1. through 4.

For the purposes of 780 CMR 121.7.5., an "*emergency situation*" shall be defined as: an unexpected incident, which by its very nature may present a threat to public safety personnel who may be required to affect a rescue effort or conduct fire extinguishment operations.

Upon refusal or neglect of said owner to comply with such notice, any building official acting under the authority of 780 CMR 121.3 or 121.5, shall cause to be secured all window and door openings accessible from grade in accordance with the U.S. Fire Administration, National Arson Prevention Initiative Board-up Procedures or other equivalent procedure approved by the head of the fire department, continuously until such time as the building is reoccupied.

Any building which has been made to conform to the provisions of 780 CMR 121.7 during vacancy may be reoccupied under its last permitted use and occupancy classification, provided that any systems which were disconnected or shut down during the period of vacancy are restored to fully functional condition and subject to 780 CMR 111.2 and M.G.L. c. 40A. The local building official shall be notified in writing prior to re-occupancy. If said building is changed in use or occupancy or otherwise renovated or altered it shall be subject to the applicable provisions of 780 CMR 34.

121.8 Marking or identifying certain buildings that are especially unsafe in the case of fire. Any building official who determines that a building is especially unsafe in case of fire under 780 CMR 121.2, shall notify the head of the fire department about the existence of said building. The building official, in cooperation with the head of the fire department, shall cause said building to be marked in accordance with the marking requirements established by the Board of Fire Prevention Regulations in 527 CMR 10.00.

780 CMR 122.0 BOARD OF APPEALS

122.1 State Building Code Appeals Board: Except for actions taken pursuant to 780 CMR 121.0, whoever is aggrieved by an interpretation, order, requirement, direction or failure to act under 780 CMR by any agency or official of the city, town or region, or agency or official of the State charged with the administration or enforcement of 780 CMR or any of its rules or regulations, excepting any specialized codes, may appeal directly to the State Building Code Appeals Board as provided in 780 CMR 122.0.

Whoever is aggrieved by an interpretation, order, requirement, direction or failure to act under 780 CMR by any agency or official of a city, town or region charged with the administration or enforcement of 780 CMR, excepting any specialized codes, may appeal directly to the State Building Code Appeals Board or may appeal first to a local or regional building code appeals board and if aggrieved thereby he may then appeal to the State Building Code Appeals Board as provided in 780 CMR 122.0.

In the event an appeal is taken directly to the State Building Code Appeals Board from an interpretation, order, requirement or direction, said appeal shall be filed as specified in 780 CMR 122.3.1 with the State Building Code Appeals Board not later than 45 days after the service of notice

NON-TEXT PAGE

#317

THE COMMONWEALTH OF MASSACHUSETTS
William Francis Galvin
Secretary of the Commonwealth

Notice of Compliance
Regulation Filing *To be completed by filing agency*

CHAPTER NUMBER: 780 CMR 3

CHAPTER TITLE: Use or Occupancy

AGENCY: Department of Public Safety / Board of Building Regulations and Standards

THIS REGULATION WAS ORIGINALLY ADOPTED AS AN EMERGENCY:

Published in Massachusetts Register Number: #1034 *Date:* 9/9/05

PRIOR NOTIFICATION AND/OR APPROVAL - *If prior notification to and/or approval of the Governor, Legislature or others was required, list each notification, and/or approval and date, including notice to the Local Government Advisory Commission.*

Local Government Notice on 4/21/04 and 10/18/04, respectively

PUBLIC REVIEW- *M.G.L. c. 30A, §§ 2 and/or 3 requires notice of the hearing or comment period to be filed with the Secretary of the Commonwealth, published in appropriate newspapers, and sent to persons whom specific notice must be given at least 21 days prior to such hearing or comment period.*

Date of public hearing or comment period: Comment Period thru 6/11/04 and 12/9/04 respectively

Publication - *To be completed by the Regulations Division*

MASSACHUSETTS REGISTER NUMBER: #1034 DATE: 9/9/05

EFFECTIVE DATE: 8/26/05

CODE OF MASSACHUSETTS REGULATIONS

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William Francis Galvin
WILLIAM FRANCIS GALVIN
SECRETARY OF THE COMMONWEALTH
DATE 8/26/05 CLERK

thereof of the interpretation, order, requirement or direction.

In the event the appeal is taken directly to the State Building Code Appeals Board for the failure to act, the appeal shall be taken not later than 45 days after a request to act has been made by the aggrieved person in writing and served upon the appropriate building official or chief administrative officer of the state or local agency which fails to act.

If the aggrieved person elects to appeal before the local or regional building code appeals board, he shall not be allowed to enter such appeal with the State Building Code Appeals Board until such time as the said local or regional board renders a decision, unless the reason for appeal to the State Building Code Appeals Board is the failure of the local or regional board to act.

122.2 Membership:

122.2.1 Three member panel: The State Building Code Appeals Board (hereinafter referred to in 780 CMR 122.0 as the Board) shall consist of the membership of the BBRS. The chairman of the BBRS shall be Chairman of the Board. The Chairman of the Board may designate any three members of the Board to act as a three member panel to hold any public hearing under 780 CMR 122.0 and to hear testimony and take evidence. The Chairman of the Board shall select one of the three members to act as chairman of the said three member panel. If a three member panel is so designated, the three member panel shall act as the Appeals Board and render a decision as provided in 780 CMR 122.0.

122.2.2 Clerk: The administrator of the BBRS shall designate a clerk to the BBRS. The clerk shall keep a detailed record of all decisions and appeals and a docket book on file showing the name of each appeal properly indexed and the disposition of the appeal. Said docket book shall be open to public inspection at all times during normal business hours.

122.2.3 Quorum: A majority of the Board shall constitute a quorum if the appeal is heard by the entire Board.

122.3 Appeals procedure for State Building Code Appeals Board:

122.3.1 Entry: Appeals shall be entered on forms provided by the BBRS and shall be accompanied by an entry fee of $150 or such other amounts as may be determined by the BBRS from time to time.

The appeal shall be signed by the appellant or his attorney or agent and shall note the name and address of the person or agency in whose behalf the appeal is taken and the name of the person and address wherein service of notice for the appellant is to be made. The appeal shall also state in detail the interpretation, order, requirement, direction or failure to act which are the grounds of the appeals as well as the particular section or sections of 780 CMR which are involved in the appeal and the reasons for the appellant advances supporting the appeal.

A copy of the appeal shall be served in accordance with 780 CMR 118.6 by the appellant on the person or state, regional or local agency from whose action or inaction the appeal is taken, on or before entry of the appeal. An affidavit, under oath, that such copy has been served shall be filed with the Board forthwith by the appellant.

122.3.2 Stay of Proceedings: Entry of an appeal shall stay all proceedings in furtherance of the action or failure to act appealed from, unless the state, regional or local agency or any person charged with the administration or enforcement of 780 CMR presents evidence and the Board or a three member panel or a single member of the Board, appointed by the chairman for said purpose, finds that upon the evidence presented a stay would involve imminent peril to life or property. In such an event, stay of all proceedings shall be waived or the Board or three member panel or single member may order such other action necessary to preserve public safety.

Before waiving the stay or proceedings, the Board or three member panel or single member of the Board, appointed by the chairman for said purpose, shall hold a hearing and give the appellant and state, regional or local agency or any person claiming that a stay would involve imminent peril to life or property, notice in writing of the hearing not less than 24 hours before said hearing.

122.3.3 Documents: Upon entry, the clerk shall request in writing from the state, city, regional or town officer in charge of the matter on appeal, a copy of the record and all other papers and documents relative to the appeal to be transmitted forthwith to the Board. Said state, city, regional or town officer shall upon receipt of the request of the Board transmit forthwith all the papers and documents and a copy of the record relating to the matter on appeal.

122.3.4 Hearings: The chairman of the Board shall fix a convenient time and place for a public hearing. Said hearings shall be held not later than 30 days after the entry of such appeal, unless such time is extended by agreement with the appellant. Any such party may appear in person or by agent or attorney at such hearing. The chairman or clerk shall give notice of the time and place of said hearing to all parties to the hearing and to anyone else requesting notice in writing at least ten days prior thereto. Failure to hold a public hearing within 30 days shall not affect the validity of the appeal or any decision rendered. The Board or three member panel in its hearings conducted under this section shall not be bound by strict rules of evidence prevailing in courts of law or equity.

122.3.5 Conduct of Hearing: Hearing shall be conducted in accordance with the informal/fair hearing rules as set forth in 801 CMR 1.02.

122.4 Decisions:

122.4.1 Votes required: If the appeal is conducted by a three member panel, then the concurrence of two of the three members holding the public hearing shall be required. If the appeal is conducted by the entire Board, then a majority vote of those hearing the case shall be required.

122.4.2 Standard: The Board or a three member panel may vary the application of any provision of 780 CMR in any particular case, may determine the suitability of alternate materials and methods of construction, and provide reasonable interpretations of the provisions of 780 CMR; provided that the Board or a three-member panel finds that the decision to grant a variance shall not conflict with the general objectives set forth M.G.L. c. 143, § 95 or with the general objectives of 780 CMR.

122.4.3 Time for decision: The Board shall within 30 days after such hearing, unless such time is extended by agreement of the parties, issue a decision or order reversing, affirming or modifying in whole or in part the order, interpretation, requirement, direction or failure to act which is the subject matter of the appeal.

Failure to render a decision within 30 days shall not affect the validity of any such decision or appeal.

Notice of and a copy of the decision shall be sent by the clerk to all parties to the appeal and anyone requesting in writing a copy of the decision.

122.4.4 Contents of decision: All decisions shall be in writing and state findings of fact, conclusions and reasons for decisions. Every decision shall indicate thereon the vote of each member and shall be signed by each member voting. A decision shall not be considered by any person or agency as a precedent for future decisions.

122.4.5 Additional powers: The Board or a three member panel may impose in any decision, limitations both as to time and use, and a continuation of any use permitted may be conditioned upon compliance with future amendments to 780 CMR.

122.5 Enforcement: Upon receipt of the decision of the Board or a three member panel, the parties to the appeal shall take action forthwith to comply with the decision unless a later time is specified in the decision.

122.6 Appeals from State Building Code Appeals Board: Any person aggrieved by a decision of the State Building Code Appeals Board may appeal to a court of law or equity in conformance with M.G.L. c. 30A, § 14.

122.7 Local and regional board of appeals:

122.7.1 Local or regional board of appeals: Whoever is aggrieved by an interpretation, order, requirement, direction or failure to act under 780 CMR by any agency or official of a city, region or town charged with the administration or enforcement of 780 CMR or any of its rules and regulations may appeal first to the appeals board in that city, region or town or to the State Building Code Appeals Board as provided in 780 CMR 122.0.

In the event an appeal is taken from an interpretation, order, requirement or direction, said appeal shall be filed with the local or regional appeals board not later than 45 days after the service of notice thereof of the interpretation, order, requirement or direction.

In the event the appeal is taken for the failure to act, the appeal shall be taken not later than 45 days after a request to act has been made by the aggrieved person in writing and served to the appropriate building official or chief administrative officer of the city, regional or town agency which fails to act.

122.7.2 Membership: Any building code board of appeals duly established by ordinance or by law or otherwise in a city, region or town and in existence on January 1, 1975, shall qualify as a local board of appeals under 780 CMR 122.0 notwithstanding anything to the contrary contained herein. However, the procedure and rights for appeals for such board of appeals shall be governed by 780 CMR.

If a city, region or town had not duly established by ordinance or bylaw or otherwise a local or regional building code appeals board prior to January 1, 1975, said city, region or town may establish a local or regional board of appeals, hereinafter referred to as the local board of appeals, consisting of five members appointed by the chief administrative officer of the city, region or town: one member appointed for five years, one for four years, one for three years, one for two years and one to serve for one year; and thereafter each new member to serve for five years or until his successor has been appointed.

122.7.3 Qualifications of local board members: Each member of a local board of appeals established under 780 CMR 122.7.2 shall have had at least five years experience in the construction, alteration, repair and maintenance of building and building codes. At least one member shall be a registered structural or civil professional engineer and one member a licensed registered architect.

122.7.4 Chairman of local or regional board: The board shall select one of its members to serve as chairman and a detailed record of all proceedings shall be kept on file in the building department.

122.7.5 Absence of members: During the absence of a member of a local board of appeals for reason of disability or disqualification, the chief administrative officer of the city, region or town shall designate a substitute who shall meet the qualifications as outlined in 780 CMR 122.7.3.

122.7.6 Quorum: A quorum shall be three members.

122.7.7 Procedures: Entry of appeals shall be governed by 780 CMR 122.3.1 excepting that a city, region or town may set its own entry fee.

Upon notice of entry of appeal the local building commissioner or inspector of buildings shall transmit a copy of the record and all the papers and documents to the local board of appeals.

Entry of an appeal shall stay all proceedings in furtherance of the action or failure to act appealed from, unless the building commissioner or inspector of buildings certifies in writing to the local board of appeals that a stay would involve imminent peril to life or property. Notice in writing of such certification by the building commissioner or inspector of buildings shall be given the appellant at least 24 hours prior to the hearing. In such an event a hearing on such stay shall be given first priority and be the first matter heard by the local board of appeals at its next scheduled meeting. The hearing on the appeal shall be held as soon as possible thereafter in accordance with 780 CMR 122.7.8.

The local board of appeals may establish its own rules for procedure not established herein or not inconsistent with 780 CMR or with the general objectives set forth in M.G.L. c. 143, § 95.

122.7.8 Hearings: All hearings shall be public and notice of said hearings shall be advertised in a newspaper of general circulation in the city, region or town in which the appeal is taken at least ten days before said hearing. Notice of the hearing, setting forth the date and time of said hearing, shall be mailed by the local board of appeals to all parties and all those who requested notice in writing at least 14 days before said hearing. Said hearings shall be held not later than 30 days after the entry of such appeal, unless such time is extended by agreement with the appellant. This section as it pertains to notice shall not apply to hearings on a stay as provided in 780 CMR 122.7.7.

122.7.9 Decisions of local boards: A concurring vote of a majority of all the members present shall be required for any decision. The local board of appeals may vary the application of 780 CMR to any particular case, may consider the suitability of alternate materials and methods of construction and may provide reasonable interpretations of the provisions of 780 CMR; provided that the decision of the local board shall not conflict with the general objectives of 780 CMR or with the general objectives of M.G.L. c. 143, § 95. The local board of appeals may impose, in any decision, limitations both as to time and use, and a continuation of any use permitted may be conditioned upon compliance with future amendments to 780 CMR.

122.7.10 Time for decision: The board shall within 30 days after such hearing, unless such time is extended by agreement of the parties, issue a decision or order reversing, affirming or modifying in whole or in part the order, interpretation, requirement, direction or failure to act which is the subject matter of the appeal.

Failure to render a decision within 30 days shall not affect the validity of any such decision or appeal.

Notice of and a copy of the decision shall be sent by the clerk to all parties to the appeal and to anyone requesting in writing a copy of the decision.

122.7.11 Contents of decision: All decisions shall be in writing and state findings of fact, conclusions and reasons for the decisions. Every decision shall indicate thereon the vote of each member and shall be signed by each member voting. Any decision shall not be considered by any person or agency as a precedent for future decisions.

122.7.12 Copy of decision: A copy of any decision by a local board of appeals shall be transmitted to the State Building Code Appeals Board within ten days after the rendering of such decision. If the State Building Code Appeals Board disapproves of the said decision of the local board, it may on its own motion appeal from the decision of the local board of appeals according to 780 CMR 122.0 and call for a hearing *de novo*.

If the State Building Code Appeals Board does not notify the local board in writing within 45 days from the date of the local board's decision, the said decision shall be deemed approved; provided that the decision shall not conflict with the general objectives of the state building code and the objectives of M.G.L. c. 143, § 95.

122.7.13 Enforcement of decision: If said decision is approved by the State Building Code Appeals Board, all parties to the appeal shall take immediate action in accordance with the decision of the local board unless the person aggrieved by such decision appeals to the State Building Code Appeals Board as provided in 780 CMR 122.0.

122.7.14 Review: Any person, including the State Building Code Appeals Board, aggrieved by a decision of the local board of appeals, whether or not a previous party to the decision, or any municipal officer or official board of the municipality, may, not later than 45 days after the mailing of the decision of the local board, apply to the State Building Code Appeals Board for a hearing de novo before the State Board, in accordance with the regulations contained in 780 CMR 122.0.

780 CMR 123.0 CONSTRUCTION MATERIALS SAFETY BOARD

123.1 Membership: There shall be a board under the control of the BBRS called the Construction Materials Safety Board, hereafter in 780 CMR 123.0 called the CMSB which shall consist of nine members, one of whom shall be a member of the BBRS who shall be ex-officio and a voting member of the Board and eight members to be appointed by the chairman of the BBRS: one of whom shall be a registered professional engineer who is a structural engineer; one of whom shall be a registered architect; one of whom shall be a representative of a commercial testing laboratory; one of whom shall be a representative of a public testing laboratory; two of whom shall be representatives from the construction industry; one of whom shall be a member of a university faculty engaged in research and teaching in structural materials; and one of whom shall be a member of a university faculty engaged in research and teaching in the area of theoretical and applied mechanics.

123.2 Duties: The CMSB will review applications for registration or licensing of individuals, laboratories or firms responsible for the inspection, control and testing of construction materials, and review applications and pertinent data relevant to all materials, devices, products and methods of construction not included in 780 CMR; and report to the BBRS their recommendations. The CMSB will collect information and review cases where disciplinary action against an existing license, whether an individual, laboratory or firm, has been proposed; and make recommendations to the BBRS. The BBRS will issue applications, receive payment for the review of such applications and approvals, registration and licensing fees, and maintain records for the efficient dispatch of the duties of the CMSB.

123.3 Testing and evaluation groups: The BBRS shall establish and maintain testing and evaluation groups who will have the responsibility of administering and directing, under the supervision of the BBRS, the testing and controls for evaluating individual applicants, laboratories and firms wishing to become registered or licensed.

780 CMR 124.0 FIRE PREVENTION -FIRE PROTECTION ADVISORY COMMITTEE

124.1 Constitution of the Fire Prevention - Fire Protection Advisory Committee: There shall be a Committee under the control of the BBRS called the Fire Prevention - Fire Protection Advisory Committee, hereinafter called the FPFP Advisory Committee which shall consist of 17 members, two of whom shall be members of the BBRS; one of whom shall be the State Fire Marshal or his designee; one of whom shall be the Commissioner of the City of Boston Fire Department or his designee; all four of whom shall be ex-officio and voting members of the Committee, and 12 members to be appointed by the chairman of the BBRS for a term of one year; two of whom shall be representatives of the Fire Chiefs Association of Massachusetts; two of whom shall be representatives of the Fire Prevention Association of Massachusetts; one of whom shall be a representative of the International Municipal Signalmen's Association; one of whom shall be a member of the State Board of Fire Prevention Regulations; one of whom shall be a member of the Board of State Examiners of Electricians who satisfies the requirements of that Board as a systems contractor holding a certificate C license and is actively engaged in the business of fire warning systems; one of whom shall be a Massachusetts building official; one of whom shall be a Massachusetts registered Fire Protection Engineer; one of whom shall be a Massachusetts registered professional engineer or architect; one of whom shall be a Massachusetts registered professional engineer with specific experience in the design and installation of smoke control systems. and; one of whom shall be a *sprinkler system* installer who shall be certified by the National Institute for Certification in Engineering Technologies (NICET), and; one of whom shall be a member proposed jointly by the Massachusetts Burglar and Fire Alarm Association and the Automatic Fire Alarm Association and the Automatic Fire Alarm Association, New England.

The FPFP Advisory Committee shall elect a chairman and a vice chairman and each shall serve for a term one year. A member of an agency or board of the state shall not be eligible for the office of chairman or vice chairman.

124.2 Purpose: The FPFP Advisory Committee shall review and recommend to the BBRS changes to 780 CMR relating to fire prevention and *fire protection* and more specifically those matters contained in 780 CMR 9.

780 CMR 125.0 STRUCTURAL PEER REVIEW ADVISORY COMMITTEE

125.1 Membership: There shall be a Board under the control of the BBRS called the Structural Peer Review Advisory Committee, which shall consist of seven members, six of whom shall be professional engineers, registered in Massachusetts, each having a minimum of ten years of structural design experience and shall be appointed by the BBRS from nominations submitted by the Boston Association of Structural Engineers, the Boston Society of Civil Engineers and the American Consulting Engineers Council of New England. The seventh member shall be the structural engineer member of the BBRS who shall serve as chairman of said Advisory Board.

125.2 Quorum: The chairman of said Advisory Committee shall appoint three of the members to mediate the disputes by a majority vote of the three members.

125.3 Purpose: The Structural Peer Review Advisory Committee shall mediate any unresolved disputes between the engineer of record and the reviewing engineer which may result from the independent structural engineer review specified in 780 CMR 110.11.

125.4 Procedure: The structural engineer of record or the reviewing engineer or the owner or the building official shall submit any unresolved disputes cited in Appendix I-5 (3), to the Structural Peer Review Advisory Committee on a form provided for this purpose. Said Committee shall convene a mediation hearing within 30 days from the receipt of the application and render a decision in writing within 30 days following the mediation hearing.

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CHAPTER 2

DEFINITIONS

780 CMR 201.0 GENERAL

201.1 Scope: Unless otherwise expressly stated, the following words and terms shall, for the purposes of 780 CMR, have the meanings shown in 780 CMR 2.

201.2 Interchangeability: Words used in the present tense include the future; words used in the masculine gender include the feminine and neuter; the singular number includes the plural and the plural the singular.

201.3 Terms defined in other codes: Where terms are not defined in 780 CMR and are defined in the plumbing (248 CMR), fire prevention (527 CMR) or BOCA mechanical codes *or other reference standards* listed in *Appendix A*, such terms shall have the meanings ascribed to them as in those codes.

201.4 Terms not defined: Where terms are not defined through the methods authorized by 780 CMR 201.0, such terms shall have *the* ordinarily accepted meanings such as the context implies.

201.5 Applications of other laws : Nothing herein contained shall be deemed to nullify any provisions of the zoning by-laws or ordinance of any municipality in the Commonwealth of Massachusetts insofar as those provisions deal exclusively with those powers of regulating zoning granted by the provisions of M.G.L. c. 40A and 41 or St. 1956, c. 665, as amended.

780 CMR 202.0 GENERAL DEFINITIONS

Acceleration: See 780 CMR 1612.3.

Accepted engineering practice: That which conforms to accepted principles, tests or standards of nationally recognized technical or scientific authorities.

Accessible: See 780 CMR 1101.0.

Accessible route: See 780 CMR 1101.0.

Accessory structure: A building, the occupancy of which is incidental to that of the main building, that is located on the same lot as the main building.

Adaptability: See 780 CMR 1101.0.

Addition: An increase in building area, aggregate floor area, height or number of stories of a structure (see 780 CMR 3400.3(4)).

Admixture: See 780 CMR 1902.0.

Aerosol: See 780 CMR 307.2.

Aerosol container: See 780 CMR 307.2.

Aisle accessway: See 780 CMR 1002.0.

Alarm verification: See 780 CMR 902.0.

Alteration: *A change or modification of a building or structure, or the service equipment thereof, that affects safety or health and that is not classified as an ordinary repair.*

Alternating tread stairway: See 780 CMR 1002.0.

Alternate Inspector: A person appointed to act in the absence of the inspector of buildings or building commissioner in case of illness, disability, or conflicting interest. An alternate inspector shall meet or exceed the minimum qualifications defined by M.G.L. c. 143, § 3 for an inspector of buildings/building commissioner and shall be certified in accordance with 780 CMR R7. See also 780 CMR 105.2

Anchor: See 780 CMR 2102.0.

Anchor Store: See 780 CMR 402.2.

Approval: When used in 780 CMR 35 for manufactured buildings or building components, approved by the State Board of Building Regulations and Standards, hereinafter known as the BBRS.

Approved agency: See 780 CMR 1702.0.

Approved material, equipment and methods: Material, equipment and methods evaluated and approved (see 780 CMR 109.0).

Approved rules: The legally adopted rules of the code official (see 780 CMR 106.0).

Appurtenant structure: A device or structure attached to the exterior or erected on the roof of a building designed to support service equipment or used in connection therewith. or for advertising or display purposes, or other similar **uses.**

Architectural terra cotta: See 780 CMR 2102.0.

Area, building: See 780 CMR 502.0.

Area, gross cross-sectional: See 780 CMR 2102.0.

Areaway (form of construction): See 780 CMR 3203.2.

Attic: See 780 CMR 1202.0.

Automatic: See 780 CMR 902.0.

Automatic fire suppression system: See 780 CMR 902.0.

Barricade: See 780 CMR 307.2.

Base: See 780 CMR 1612.3.

Base shear: See 780 CMR 1612.3.

Basement: See 780 CMR 502.0.

Bay (part of a structure): See 780 CMR 1612.3.

B.B.R.S.: (Massachusetts) Board of Building Regulations and Standards.

Bed joint: See 780 CMR 2102.0.

Bleachers: See 780 CMR 1002.0.

Blocked diaphragm: See 780 CMR 2306.2.

Boiling point: See 780 CMR 307.2.

Box system: A structural system where the vertical load is carried by bearing walls and structural framing and where the lateral stability and lateral force resisting system consists of shear walls or braced wall.

Brick
Calcium silicate brick (sand lime brick): See 780 CMR 2102.0.
Clay or shale: See 780 CMR 2102.0.
Concrete brick: See 780 CMR 2102.0
Hollow brick: See 780 CMR 2102.0.

Building: *A structure enclosed within exterior walls or firewalls, built, erected and framed of a combination of any materials, whether portable or fixed having a roof, to form a structure for the shelter of persons, animals or property. For the purpose of this definition, "roof" shall include an awning or similar covering, whether or not permanent in nature. The word "building shall be construed where the context requires as though followed followed by the words "or parts thereof".* For application of 780 CMR, each portion of a building which is completely separated from other portions by fire walls complying with 780 CMR 707.0 shall be considered as a separate building.

Building Code Enforcement Official: The term used to collectively refer to Inspector of Buildings, Building Commissioners, and Local Inspectors. All building code enforcement officials shall meet or exceed the minimum qualifications for the position as defined by M.G.L. c.143, § 3 and shall be certified in accordance with 780 CMR R7.

Building Commissioner: The Administrative chief of the building department in a municipality who is charged with the administration and enforcement of 780 CMR (See also "Inspector of Buildings" and 780 CMR 105.0). All building commissioners shall meet or exceed the minimum qualifications for the position as defined in M.G.L. c.143 § 3 and shall be certified in accordance with 780 CMR R7.

Building Component: Any subsystem, subassembly, or other system designed for use in or as part of a structure having concealed elements such as electrical, mechanical, plumbing and fire protection systems and other systems protecting health and safety.

Building, existing: Any structure occupied prior to the date of adoption of the appropriate code, or one for which a legal building permit has been issued. *(See also 780 CMR 3400.3.1).* For purposes of energy conservation requirements, a building which has been legally occupied and/or used for a period of at least five years.

Building line: The line established by law, beyond which a building shall not extend, except as specifically provided by law.

Building service equipment: The mechanical, electrical and elevator equipment including piping, wiring, fixtures and other accessories, which provides sanitation, lighting, heating, ventilation, fire protection and transportation facilities essential for the habitable occupancy of the building or structure for its designated occupancy.

Building site: The area occupied by a building or structure, including the yards and courts required for light and ventilation, and such areas that are prescribed for access to the street.

***Bulk** Merchandizing Retail Building: (See 780 CMR 426.0.) Mercantile Buildings where sales areas contain:*

1. Combustible materials in piles greater than 12 feet in height, or combustible materials on pallets, in racks or on shelves where the top of storage is greater than 12 feet in height, or

2. Combustible materials such as rubber tires, Group A plastics, flammable liquids, idle pallets and commodities with similar heat release characteristics, where the top storage is greater than six feet in height.

Buttress: See 780 CMR 2102.0.

Cellar: that portion of a building which is partly or completely below grade and having at least ½ its height below grade.

NON-TEXT PAGE

Cementitious material: See 780 CMR 1902.0.

Central Station, Central Station Fire Alarm Systen and Central Station Services: See NFPA 72, as listed in Appendiz A.

Certificate of approval: A written document from the appropriate code official approving an action, type of material, and the like.

Certificate of use and occupancy: The certificate issued by the code official which permits the use of a building in accordance with the approved plans and specifications which certifies compliance with provisions of law for the use and occupancy of the building in its several parts together with any special stipulations or conditions of the building permit.

Certification: Any manufactured building or building component that meets the provisions of 780 CMR 35 and the rules and regulations pursuant thereto and which has been labeled accordingly. See also 780 CMR R7 for the certification of Building Code Enforcement Officials

Change of use: An alteration by change of use in a building heretofore existing to a new use group which imposes other special provisions of law governing building construction, equipment or means of egress.

Child day care center: Any facility operated on a regular basis whether known as a day nursery, nursery school, kindergarten, child play school, progressive school child development center, or preschool, or known under any other name, which receives children not of common parentage under seven years of age or under 16 years of age if such children have special needs for non-residential custody and care during part or all of the day separated from their parents. Child day care centers shall not include: any part of a public school system; any part of a private, organized educational system unless the services of such a system are primarily limited to a kindergarten, nursery or related preschool services; a Sunday school conducted by a religious institution; a facility operated by religious organization where children are cared for during short periods of time while persons responsible for such children are attending religious services; a family day care home, as defined by M.G.L. c. 28A, § 9; an informal cooperative arrangement among neighbors or relatives; or the occasional care of children with or without compensation therefor.

Chimney: See 780 CMR 2102.0.

Chimney, masonry: See 780 CMR 2102.0.

Closed system: See 780 CMR 307.2.

CMR: *Code of Massachusetts Regulations; Appendix A contains a listing of various CMR's for Massachusetts specialized codes.*

Code official: *See "Building Code Enforcement Official".*

Combination of municipalities: Any two or more cities and/or towns who have agreed to combine in order to share costs necessary for the administration and enforcement of 780 CMR in said cities and/or towns.

Collar joint: See 780 CMR 2102.0.

Combustible dusts: See 780 CMR 307.2.

Combustible fibers: See 780 CMR 307.2.

Combustible liquids: See 780 CMR 307.2.

Combustible material: A combustible material is a material which cannot be classified as non-combustible in accordance with 780 CMR 704.4.1.1.

Compliance assurance program: The system, documentation and methods for assuring that manufactured buildings, building components, building systems and manufactured homes, including their manufacture, storage transportation and assembly, and handling and installation, conform with 780 CMR 35 and the rules and regulations promulgated pursuant thereto.

Commercial Building: For purposes of energy conservation requirements only, a *commercial building* is any building other than a *low-rise residential building*, as defined in 780 CMR 2.0 and 780 CMR Appendix J, Section J2.0 (See also *Low-rise residential building definition.)*

Common path of travel: See 780 CMR 1002.0.

Compressed gas: See 780 CMR 307.2.

Concrete: See 780 CMR 1902.0.

Concrete, reinforced: See 780 CMR 1902.0.

Connector: See 780 CMR 2102.0.

Construction documents: All of the written, graphic and pictorial documents prepared or assembled for describing the design, location and physical characteristics of the elements of the project necessary for obtaining a building permit. The construction drawings shall be drawn to an appropriate scale.

Construction, type of: See 780 CMR 602.0.
Type 1: See 780 CMR 603.0.
Type 2: See 780 CMR 603.0.
Type 3: See 780 CMR 604.0.
Type 4: See 780 CMR 605.0.
Type 5: See 780 CMR 606.0

Control area: See 780 CMR 307.2.

Corridor: See 780 CMR 1002.0.

Corrosive: See 780 CMR 307.2.

Court: See 780 CMR 1202.0.
Inner: See 780 CMR 1202.0.
Outer: See 780 CMR 1202.0.

Court width: See 780 CMR 1202.0.

Cryogenic liquids (flammable or oxidizing): See 780 CMR 307.2.

Curb level: See 780 CMR 3203.2.
Building or wall height: See 780 CMR 3203.2.

Damper, fire: See 780 CMR 702.0.

Day care center (child): See "Child day care center".

Deflagration: See 780 CMR 307.2.

Deluge system: See 780 CMR 902.0.

Department: (DPS): The Department of Public Safety, Division of Inspection.

Design earthquake: See 780 CMR 1612.3.

Designated seismic systems: See 780 CMR 1612.3.

Detached storage building: See 780 CMR 307.2.

Detector, heat: See 780 CMR 902.0.

Detector, smoke: See 780 CMR 902.0.

Detonation: See 780 CMR 307.2.

Detoxification facility: A facility licensed or operated by the Department of Public Health, Division of Alcoholism in accordance with 105 CMR 160.000: Acute Care Inpatient Substance Abuse Detoxification Treatment Services issued by the Department of Public Health, Division of Alcoholism, Commonwealth of Massachusetts, and shall be used to treat individuals acceptable to the program in accordance with 105 CMR 160.000.

Diaphragm: See 780 CMR 1612.3, 2102.0 and 2306.2.

Dimensions, nominal: See 780 CMR 2102.0.

Dispensing: See 780 CMR 307.2.

Door assembly, fire: See 780 CMR 702.0.

Door, fire: See 780 CMR 702.0.

DPS: See "Department".

Draftstopping: See 780 CMR 702.0.

Dumbwaiter: See 780 CMR 30.

Dwellings
Boarding house: See 780 CMR 310.2.
Dormitory: See 780 CMR 310.2.
Dwelling unit: See 780 CMR 310.2.
Hotel: See 780 CMR 310.2.
Motel: See 780 CMR 310.2.
Multiple-family dwelling: See 780 CMR 310.2.
Multiple single-family dwelling: See 780 CMR 310.2.
One-family dwelling: See 780 CMR 310.2.
Two-family dwelling: See 780 CMR 310.2.

Effective height: See 780 CMR 2102.0.

Elevator: 780 CMR 30 and 524 CMR.
Freight elevator: See 524 CMR 17.00
Hand elevator: See 524 CMR 18.00
Hydraulic elevator: See 524CMR
Passenger elevator: See 524CMR 17.00
Power elevator: See 524CMR.
Sidewalk elevator: See 524CMR 20.00

Elevator repairs: 780 CMR 30 and 524 CMR.

Emergency control station: See 780 CMR 416.2.

Equipment, existing: Any equipment regulated by 780 CMR which was legally installed prior to the effective date of 780 CMR, or for which a permit to install has been issued.

Escalator: 780 CMR 30 and 524 CMR.

Exit: See 780 CMR 1002.0.

Exit access: See 780 CMR 1002.0.

Exit discharge: See 780 CMR 1002.0.

Exit discharge, level of: See 780 CMR 1002.0.

Exit, horizontal: See 780 CMR 1002.0.

Explosive: See 780 CMR 307.2.

Exterior envelope: See 780 CMR 1302.0.

Exterior wall finish: See 780 CMR 1402.0.

Fabric awning: See 780 CMR 1609.2.

Fabric canopy: See 780 CMR 1609.2.

Fabricated item: See 780 CMR 1702.0.

Fabrication area: See 780 CMR 416.2.

Fire alarm box, manual: See 780 CMR 902.0.

Fire area: See 780 CMR 702.0.

Fire command station: See 780 CMR 902.0.

Fire detector, automatic: See 780 CMR 902.0.

Fire hazard: The potential degree of fire severity based on the occupancy of a structure, classified as high, moderate or low.

High: All occupancies which involve the storage, sale manufacture or processing of highly combustible, volatile flammable or explosive products which are capable of burning with extreme rapidity and produce explosions or large volumes of smoke, poisonous fumes or gases in the event of fire.

Moderate: All occupancies which involve the storage, sale, manufacture or processing of materials which are capable of burning with moderate rapidity and a considerable volume of smoke, but which do not produce either poisonous fumes or explosions. in the event of fire.

Low: All occupancies which involve the storage, sale or manufacture of materials that do not ordinarily burn rapidly, nor produce excessive smoke, poisonous fumes or explosions in the event of fire.

Fire partition: See 780 CMR 702.0.

Fire protection: The provision of construction safeguards and exit facilities; and the installation of fire alarm, fire-detecting and fire-extinguishing service equipment to reduce the fire risk, including the risk involved in the spread of fire by exterior exposure to and from adjoining buildings and structure.

Fire protection rating: See 780 CMR 702.0.

Fire protection system: See 780 CMR 902.0.

Fire window: See 780 CMR 702.0.

Fireresistance: See 780 CMR 702.0.

Fireresistance rating: See 780 CMR 702.0.

Firestopping: See 780 CMR 702.0.

Fire separation assembly: See 780 CMR 702.0.

Fire separation distance: *The distance in feet measured from the building face to the closest interior lot line, to the center line of a street or public way or to an imaginary line between two buildings on the same property.*

Flame spread: See 780 CMR 802.0.

Flame spread rating: See 780 CMR 802.0.

Flameresistance: See 780 CMR 802.0.

Flammable: See 780 CMR 307.2.

Flammable compressed gas: See 780 CMR 307.2.

Flammable liquids: See 780 CMR 307.2.

Flammable solid: See 780 CMR 307.2.

Flash point: See 780 CMR 307.2.

Floor area, gross: See 780 CMR 1002.0.

Floor area, net: See 780 CMR 1002.0.

Floor finish: See 780 CMR 802.0.

Frame
Braced: See 780 CMR 1612.3.
Concentrically braced frame: See 780 CMR 1612.3.
Eccentrically braced frame: See 780 CMR 1612.3.
Diagonal brace: See 780 CMR 1612.3.
Lateral support members: See 780 CMR 1612.3.
Link beam: See 780 CMR 1612.3.
Link beam end web stiffeners: See 780 CMR 1612.3.
Link beam intermediate web stiffener: See 780 CMR 1612.3.
Link beam rotation angle: See 780 CMR 1612.3.
Intermediate moment frame: See 780 CMR 1612.3.
Ordinary moment frame: See 780 CMR 1612.3.
Space frame: See 780 CMR 1612.3.
Special moment frame: See 780 CMR 1612.3.

Frame system
Building: See 780 CMR 1612.3.
Dual: See 780 CMR 1612.3.

Moment resisting: See 780 CMR 1612.3.

Garage, private: See 780 CMR 407.2.

Garage, public: See 780 CMR 408.2.

Grade hallway, grade lobby, grade passageway: See 780 CMR 1002.0.

Grade plane: See 780 CMR 502.0.

Grandstand: See 780 CMR 1002.0.

Greenhouse: See 780 CMR 3602.

Gross leasable area: See 780 CMR 402.2.

Habitable space: Space in a structure for living, sleeping, eating, or cooking. Bathrooms, toilet compartments, closets, halls, storage or utility space and similar areas are not considered habitable space.

Hazard Index: See 780 CMR 3401.0

Hazardous materials: See 780 CMR 307.2.

Hazardous production material (HPM): See 780 CMR 416.2.

Head joint: See 780 CMR 2102.0.

Header (Bonder): See 780 CMR 2102.0.

Health hazard: See 780 CMR 307.2.

Heated space: See 780 CMR 1302.0.

Height:
- **Building**: See 780 CMR 502.0.
- **Court:** See 780 CMR 1202.0.
- **Story**: See 780 CMR 502.0.
- **Walls**: See 780 CMR 2102.0.

Hereafter: After the time that 780 CMR becomes effective.

Heretofore: Before the time that 780 CMR became effective.

High-temperature energy source: See 780 CMR 1612.3.

Highly toxic: See 780 CMR 307.2.

Hoist, material platform: See 780 CMR 3002.0.

Hoisting and conveying equipment, special: See 524 CMR.
- **Automotive lift**: See 524 CMR.
- **Conveyors**: See 524 CMR.
- **Freight lift**: See 524 CMR.
- **Manlifts**: See 524 CMR.

Hoisting and elevating equipment, miscellaneous: See 524 CMR.

Incompatible materials: See 780 CMR 307.2.

Inspection, special: See 780 CMR 1705.

Inspector of buildings: The administrative chief of the building department in a municipality who is charged with the administration and enforcement of 780 CMR. (See also "Building commissioner and Building Code Enforcement Official"). All inspectors of buildings shall meet or exceed the minimum qualifications defined by M.G.L. c. 143, § 3 and shall be certified in accordance with 780 CMR R7.

Installing Contractor: an individual or firm duly licensed to install apparatus, appliances, devices or accessories relative to Heating, pumping, process piping and refrigeration systems. (See 780 CMR 2801.2.1 and 1301.1.1).

Master and Journeyman Pipefitters:
M.G.L. c. l46, §§ 81, 82, 83, 84, 85, 87 and 89.
528 CMR 10.00, 11.00, and 13.00

Master and Journeyman Refrigeration Technician:
M.G.L. c. 146, § 45A, 81, 82, 83, 84, 85, 86, 88 and 89.
528 CMR 10.00, 11.00 and 13.00

Exception: heating, pumping, process piping and refrigeration systems regulated by M.G.L. c. 142, §§ 4 and 13, State Board of Examiners of Plumbers.

Inverted pendulum-type structures: See 780 CMR 1612.3.

Irritant: See 780 CMR 307.2.

Jurisdiction: The governmental unit which has adopted 780 CMR under due legislative authority.

Label: See 780 CMR 1702.0.

Light-framed wall with shear panels: See 780 CMR 1612.3.

Listed and Listing: Terms referring to equipment which is shown in a list published by an approved testing agency qualified and equipped for experimental testing and maintaining an adequate periodic inspection of current productions and whose listing states that the equipment complies with nationally recognized standards, when installed in accordance with the manufacturer's installation instructions.

Load: See 780 CMR 1602.0.

Dead load: See 780 CMR 1602.0.
Duration of load: See 780 CMR 1602.0.
Earthquake load: See 780 CMR 1602.0.
Impact load: See 780 CMR 1602.0.
Internal load: See 780 CMR 1602.0.
Lateral soil load: See 780 CMR 1602.0.
Live load: See 780 CMR 1602.0.
Wind load: See 780 CMR 1602.0.

NON-TEXT PAGE

Loadbearing wall system: See 780 CMR 1612.3.

Local enforcement agency: A department or agency in a municipality charged with the enforcement of 780 CMR and appropriate specialized codes which include, but are not limited to, 248 CMR: The State Plumbing and Gas Fitting Code, and 527 CMR 12.00: the State Electrical Code.

Local inspector: A person in the municipality who assists the building commissioner or inspector of buildings in the performance of his or her duties and is charged with the enforcement of 780 CMR. All local inspectors shall meet or exceed the minimum qualifications defined by M.G.L. c. 143, § 3 and shall be certified in accordance with 780 CMR R7.

Lot: A portion or parcel of land considered as a unit.

Lot, corner: A lot with two adjacent sides abutting upon streets or other public spaces.

Lot, interior: A lot which faces on one street or with opposite sides on two streets.

Lot line: A line dividing one lot from another, or from a street or any public place.

Lot line, interior: Any lot line other than one adjoining a street or public space.

Lot line, street: The lot line dividing a lot from a street or other public way.

Low-rise residential building: For purposes of energy conservation requirements only, residential occupancy buildings (R-2, R-3, R-4, or R-5) three stories or less in height (Exception: for purposes of energy conservation requirements, R-1 USE GROUP buildings shall be treated as *commercial buildings*).

Main windforce-resisting system: See 780 CMR 16.

Mall: See 780 CMR 402.2.

Mall building, covered: See 780 CMR 402.2.

Manufactured building: Any building which has concealed elements, such as electrical, mechanical, plumbing, fire protection, insulation and other systems affecting health and safety, and which is manufactured and assembled in manufacturing facilities, on or off the building site. Also, any building as defined above which does not have concealed elements, but which has been approved by the BBRS at the request of the manufacturer.

Masonry: See 780 CMR 2102.0.
Ashlar facing masonry: See 780 CMR 2102.0.
Ashlar masonry: See 780 CMR 2102.0.
Solid masonry: See 780 CMR 2102.0.

Masonry unit
Clay: See 780 CMR 2102.0.
Concrete: See 780 CMR 2102.0.
Hollow: See 780 CMR 2102.0.
Solid: See 780 CMR 2102.0.

Means of egress: See 780 CMR 1002.0.

Member:
Primary: See 780 CMR 1902.0.
Secondary: See 780 CMR 1902.0.

Membrane: See 780 CMR 3103.2.

Membrane structures:
Air-inflated structure: See 780 CMR 3103.2.
Air-supported structure: See 780 CMR 3103.2.
Double skin: See 780 CMR 3103.2.
Single skin: See 780 CMR 3103.2.
Cable-restrained, air-supported structure: See 780 CMR 3103.2.
Membrane-covered cable structure: See 780 CMR 3103.2.
Membrane-covered frame structure: See 780 CMR 3103.2.
Noncombustible membrane structure: See 780 CMR 3103.2.
Tent: See 780 CMR 3103.2.

Mezzanine: See 780 CMR 502.0.

Mobile home: A structure transportable in one or more sections, which is eight body feet or more in width and is 32 body feet or more in length, and which is built on a permanent chassis, and designed to be used as a dwelling with permanent foundation, when connected to the required facilities, and includes the plumbing, heating, air-conditioning and electrical systems contained therein.

Mortar: See 780 CMR 2102.0.

Mortar, surface-bonding: See 780 CMR 2102.0.

Moving walk: See 780 CMR 30.

Native lumber: Native lumber is wood processed in the Commonwealth of Massachusetts by a mill registered in accordance with 780 CMR R4. Such wood is ungraded but is stamped or certified in accordance with the requirements of 780 CMR R4. For the purpose of this definition, native lumber shall be restricted to the use in *one- and two-story dwellings, barns, sheds, agricultural and accessory buildings and other structures when permitted by 780 CMR R4.*

Nominal dimension
Lumber: See 780 CMR 2302.0.

Noncombustible: This is a general, relative term. Its precise meaning is defined in 780 CMR for specific applications.

Noncombustible building material: See 780 CMR 704.4.1.1

Occupancy: The purpose for which a building or portion thereof is used.

Occupancy, change of: A change in the purpose or level of activity within a structure that involves a change in application of the requirements of 780 CMR.

Occupant load: See 780 CMR 1002.0.

Occupiable space: See 780 CMR 1202.0.

Occupied: As applied to a building, shall be construed as though followed by the words "or intended, arranged or designed to be occupied."

Official Interpretation: A written interpretation of any provision of 780 CMR, or to its referenced standards listed in Appendix A, except specialized codes, made by the BBRS, under authority of M.G.L. c. 143, § 94(e), or by the State Building Code Appeals Board under authority of M.G.L. c. 143, § 100.

Open system: See 780 CMR 307.2.

Organic peroxide: See 780 CMR 307.2.

Oriel window: See 780 CMR 3203.2.

Owner: *Every person who alone or jointly or severally with others (a) has legal title to any building or structure; or (b) has care, charge, or control of any building or structure in any capacity including but not limited to agent, executor, executrix, administrator, administratrix, trustee or guardian of the estate of the holder of legal title; or (c) lessee under a written letter agreement; or (d) mortgagee in possession; or (e) agent, trustee or other person appointed by the courts. Each such person is bound to comply with the provisions of 780 CMR.*

Oxidizer: See 780 CMR 307.2.

P-Delta effect: See 780 CMR 1612.3.

Panel (part of a structure): See 780 CMR 1602.0.

Particleboard: See 780 CMR 2302.1.

Penthouse: See 780 CMR 1502.1.

Permit: An official document or certificate issued by the authority having jurisdiction which authorizes performance of a specified activity (see 780 CMR 111.1).

Person: Includes a corporation, firm, partnership, association, organization and any other group acting as a unit as well as individuals. It shall also include an executor, administrator, trustee, receiver or other representative appointed according to law. Whenever the word "person" is used in any section of 780 CMR prescribing a penalty or fine, as to partnerships or associations, the word shall include the partners or members thereof, and as to corporations, shall include the officer, agent or members thereof who are responsible for any violation of such section..

Physical hazard: See 780 CMR 307.2.

Physically disabled person: See 780 CMR 11.

Place of assembly: A room or space accommodating 50 or more individuals for religious, recreational, educational, political, social or amusement purposes, or for the consumption of food or drink, including all connected rooms or space with a common means of egress and entrance.

Place of outdoor assembly: Premises used or intended to be used for public gatherings of 200 or more individuals in other than buildings.

Plastic
Light-diffusing system: See 780 CMR 2602.0.
Plastic glazing: See 780 CMR 2602.0.
Plastic roof panels: See 780 CMR 2602.0.
Plastic wall panels: See 780 CMR 2602.0.
Reinforced plastic, glass fiber: See 780 CMR 2602.0.
Thermoplastic material: See 780 CMR 2602.0.
Thermosetting material: See 780 CMR 2602.0.

Platform: See 780 CMR 412.2.

Plenum: *An enclosed portion of the building structure, so designed to allow the movement of air, that forms part of an air distribution system.* See BOCA National Mechanical Code listed in Appendix A.

Pools, swimming, hot tubs and spas
Above-ground/on-ground pool: See 780 CMR 421.2.
Barrier: See 780 CMR 421.2.

Hot tub: See 780 CMR 421.2.
In-ground pool: See 780 CMR 421.2.

Private swimming pool: See 780 CMR 421.2.
Private swimming pool, indoor: See 780 CMR 421.2.
Private swimming pool, outdoor: See 780 CMR 421.2.

Public swimming pool:
Public outdoor inground swimming pool, Semi-public outdoor inground swimming pool: See 780 CMR 421.2.
Spa: See 780 CMR 421.2.

Preaction system: See 780 CMR 902.0.

Premises: A lot, plot or parcel of land, including any structure thereon.

Preservative treatment (treated material): See 780 CMR 2302.0.

Protected construction: See 780 CMR 702.0..

Public way: See 780 CMR 1002.0.

Pyrophoric: See 780 CMR 307.2.

Radioactive material: See 780 CMR 307.2.

Registered design professional: An architect or engineer registered or licensed to practice professional architecture or engineering, as defined by the statutory requirements of the professional registration laws of the *Commonwealth of Massachusetts*.

Repair: The reconstruction or renewal of any part of an existing structure for the purpose of its maintenance.

Repairs, ordinary: Any maintenance which does not affect the structure, egress, fire protection systems, fire ratings, energy conservation provisions, plumbing, sanitary, gas, electrical or other utilities. A building permit is not required for ordinary repairs (also see 780 CMR 903.1, Exceptions 1 and 2).

Required: Shall be construed to be mandatory by provisions of 780 CMR.

Resilient stable-mounting system: See 780 CMR 1612.3.

Restraining device: See 780 CMR 1612.3.
Elastic: See 780 CMR 1612.3.
Fixed: See 780 CMR 1612.3.
Seismic activated: See 780 CMR 1612.3.

Roof: See 780 CMR 1502.0.

Roof covering: See 780 CMR 1502.0.

Roof structure: See 780 CMR 1502.0.

Rubble masonry: See 780 CMR 2102.0.
Coursed rubble: See 780 CMR 2102.0.
Random rubble: See 780 CMR 2102.0.
Rough or ordinary rubble: See 780 CMR 2102.0.

Running bond: See 780 CMR 2102.0.

Seismic-resisting system: See 780 CMR 1612.3

Self-closing: See 780 CMR 702.0.

Sensitizer: See 780 CMR 307.2.

Service passage, HPM: See 780 CMR 416.2.

Shaft: See 780 CMR 702.0.

Shall: The term, where used in 780 CMR, shall be construed as mandatory.

Shear wall: See 780 CMR 1612.3.

Sign: See 780 CMR 3102.2.
Closed sign: See 780 CMR 3102.2.
Ground sign: See 780 CMR 3102.2.
Marquee sign: See 780 CMR 3102.2.
Open sign: See 780 CMR 3102.2.
Portable sign: See 780 CMR 3102.2.
Projecting sign: See 780 CMR 3102.2.
Roof sign: See 780 CMR 3102.2.
Temporary sign: See 780 CMR 3102.2.
Wall sign: See 780 CMR 3102.2.

Single membrane penetration: See 780 CMR 702.0.

Site: A parcel of land bounded by a lot line or a designated portion of a public right-of-way.

Slidescape: See 780 CMR 1002.0.

Smoke barrier: See 780 CMR 702.0.

Smoke compartment: See 780 CMR 702.0..

Smoke detector, multiple station: See 780 CMR 902.0.

Smoke detector, single station: See 780 CMR 902.0.

Smoke detector, system type: See 780 CMR 902.0.

Smokeproof enclosure: See 780 CMR 1002.0.

Specialized code: All building codes, rules or regulations pertaining to building construction, reconstruction, alteration, repair or demolition promulgated by and under the authority of the various agencies which have been authorized from time to time by the General Court of the Commonwealth of Massachusetts.

Sprinkler: See 780 CMR 902.0

Sprinkler system, automatic: See 780 CMR 902.0.

Sprinkler system, limited area: See 780 CMR 902.0.

Stack bond: See 780 CMR 2102.0.

Stage: See 780 CMR 412.2.

Stage, legitimate: See 780 CMR 412.2.

Stage, regular: See 780 CMR 412.2.

Stage, thrust: See 780 CMR 412.2.

Stairway: See 780 CMR 1002.0.

Standpipe system: See 780 CMR 902.0.

State Building Code: The Massachusetts State Building Code and amendments and rules and regulations thereto as promulgated by the State Board of Building Regulations and Standards, under M.G.L. c. 143 §§ 93 through 100.

State Inspector: An employee of the Division of Inspection, State Department of Public Safety, who is charged with administrating and enforcing 780 CMR relative to any structure or building or parts thereof that are owned by the Commonwealth or any departments, commissions, agencies or authorities of the Commonwealth. The state inspector is also charged with supervising the enforcement of 780 CMR relative to all buildings and structures other than those owned by the Commonwealth. See also 780 CMR 107.0.

Steel construction, cold-formed: See 780 CMR 2202.0.

Steel joist: See 780 CMR 2202.0.

Steel member, structural: See 780 CMR 2202.0.

Stone masonry: See 780 CMR 2102.0.

Stone masonry, ashlar: See 780 CMR 2102.0.

Stone masonry, rubble: See 780 CMR 2102.0.

Storage room, HPM, separate inside: See 780 CMR 416.2.

HPM cutoff room: See 780 CMR 416.2.
HPM inside room: See 780 CMR 416.2.

Story: See 780 CMR 502.0.

Story above grade: See 780 CMR 502.0.

Story drift ratio: See 780 CMR 1612.3.

Story shear: See 780 CMR 1612.3.

Street: A public thoroughfare (such as a street, avenue or boulevard) which has been dedicated for public use.

Structure: A combination of materials assembled at a fixed location to give support or shelter, such as a building, framework, retaining wall, tent, reviewing stand, platform, bin, fences over six feet high, sign, flagpole, recreational tramway, mast for radio antenna, or the like. The word "structure" shall be construed, where the context requires, as though followed by the words, "or part or parts thereof."

Structure, existing: A structure erected prior to the date of adoption of the appropriate code or one for which a legal building permit has been issued. *See 780 CMR 34 for further information regarding existing buildings.*

Supervisory device: See 780 CMR 902.0.

Through-penetration protection system: See 780 CMR 702.0.

Tie, wall: See 780 CMR 2102.0.

Tile: See 780 CMR 2102.0.

Tile, structural clay: See 780 CMR 2102.0.

Tires, bulk storage of: See 780 CMR 307.2.

Travel Trailer: A vehicular, portable structure built on a chassis and designed to be used for temporary occupancy for travel, recreational or vacational use; with the manufacturer's permanent identification "Travel Trailer," thereon; and when factory equipped for the road, being of any length provided its gross weight does not exceed 4500 pounds, or being of any weight provided its overall length does not exceed 28 feet.

Use group: The classification of an occupancy in accordance with 780 CMR 302.1.

Vapor retarder: See 780 CMR 1202.0.

Ventilation: See 780 CMR 1202.0.

Vertical opening: See 780 CMR 702.0.

Voice/alarm signaling system: See 780 CMR 902.0.

Wall
- **Apron wall**: See 780 CMR 1402.0.
- **Cavity wall**: See 780 CMR 2102.0.
- **Composite wall**: See 780 CMR 2102.0.
- **Dry-stacked, surface-bonded walls**: See 780 CMR 2102.0.
- **Faced wall**: See 780 CMR 2102.0.
- **Fire separation wall**: See 780 CMR 702.0.
- **Fire wall**: See 780 CMR 702.0.
- **Foundation wall**: See 780 CMR 1812.2.
- **Hollow wall**: See 780 CMR 2102.0.
- **Loadbearing wall**: See 780 CMR 1602.1.
- **Nonloadbearing wall**: See 780 CMR 1602.1.
- **Parapet wall**: See 780 CMR 2102.0.
- **Party wall**: See 780 CMR 702.0.
- **Retaining wall**: See 780 CMR 1812.2.
- **Skeleton or panel wall**: See 780 CMR 1402.0.
- **Spandrel wall**: See 780 CMR 1402.0.
- **Veneered Wall**: See 780 CMR 1402.0

Water-reactive materials: See 780 CMR 307.2.

Water supply, automatic: See 780 CMR 902.0.

Winder: See 780 CMR 1002.0.

Wood shear panel: See 780 CMR 2304.2.

Writing (written): The term shall be construed to include hand-writing, typewriting, printing, photo offset or any other form of reproduction in legible symbols or characters.

Written notice:* *A notification in writing delivered in person to the individual or parties intended; or delivered at, or sent by certified or registered mail to the last residential or business address of legal record.

Wythe: See 780 CMR 2102.0.

Yard: See 780 CMR 1202.0.

Zoning: The reservation of certain specified areas within a community or city for buildings and structures, or use of land, for certain purposes with other limitations such as height, lot coverage and other stipulated requirements. (See M.G.L. c. 40A and St. 1956, c. 665, as amended.)

NON-TEXT PAGE

CHAPTER 3

USE OR OCCUPANCY

780 CMR 301.0 GENERAL

301.1 Scope: The provisions of 780 CMR 3 shall control the classification of all buildings and structures as to use group.

301.2 Application of other laws: The provisions of 780 CMR 3 shall not be deemed to nullify any provisions of the zoning law, ***ordinance of any municipality in the Commonwealth of Massachusetts,*** or any other statute of the jurisdiction pertaining to the location or occupancy of buildings, except as is specifically required by the provisions of 780 CMR.

780 CMR 302.0 CLASSIFICATION

302.1 General: All structures shall be classified with respect to occupancy in one or more of the use groups listed below. Where a structure is proposed for a purpose which is not specifically provided for in 780 CMR, such structure shall be classified in the use group which the occupancy most nearly resembles.

1. Assembly: (see 780 CMR 303.0)	Use Groups A-1, A-2, A-3, A-4 and A-5
2. Business: (see 780 CMR 304.0)	Use Group B
3. Educational: (see 780 CMR 305.0)	Use Group E
4. Factory and Industrial: (see 780 CMR 306.0)	Use Groups F-1 and F-2
5. High Hazard (see 780 CMR 307.0):	Use Groups H-1, H-2, H-3 and H-4
6. Institutional: (see 780 CMR 308.0)	Use Groups I-1, I-2 and I-3
7. Mercantile: (see 780 CMR 309.0)	Use Group M
8. Residential: (see 780 CMR 310.0)	Use Groups R-1, R-2, R-3, R-4 and *R-5*
9. Storage: (see 780 CMR 311.0)	Use Groups S-1 and S-2
10. Utility and Miscellaneous (see 780 CMR 312.0)	Use Group U

302.1.1 Specific occupancy areas: Specific occupancy areas which are incidental to the main use group shall be separated and protected in accordance with Table 302.1.1 and shall be classified in accordance with the main use group of the portion of the building in which the specific occupancy area is located. Where the building, or portion thereof, containing the specific occupancy area is required to be protected with an *automatic fire suppression system*, the separation alternative of Table 302.1.1 shall not apply.

Exception: Specific occupancy areas within and serving a dwelling unit are not required to comply with 780 CMR 302.1.1.

Table 302.1.1
SPECIFIC OCCUPANCY AREAS

Room or area[b]	Separation[a]/protection
All use groups:	
Paint shops in occupancies other than Use Group F employing hazardous materials in quantities less than those which cause classification as Use Group H	2 hours; or 1 hour and automatic fire suppression system
Waste and soiled linen collection rooms and chute termination rooms	1 hour and automatic fire suppression system
Waste and soiled linen chute access rooms	1 hour
Boiler and furnace rooms	1 hour; or automatic fire suppression system
Incinerator rooms	2 hours and automatic fire suppression system
Use Groups A, B, E, I-1, R-1, R-2:	
Storage rooms more than 50 square feet in area but not more than 100 square feet in area	1 hour; or automatic fire suppression system with smoke partitions
Storage rooms more than 100 square feet in area	Automatic fire suppression system with smoke partitions
Physical plant maintenance shop and workshop	2 hours; or 1 hour and automatic fire suppression system
Use Groups I-2, I-3:	
Boiler and furnace rooms	1 hour and automatic fire suppression system
Handicraft shops, kitchens, and employee locker rooms	1 hour; or automatic fire suppression system with smoke partitions
Laundries greater than 100 square feet in area	1 hour and automatic fire suppression system
Storage rooms more than 50 square feet in area but not more than 100 square feet in area	Automatic fire suppression system with smoke partitions
Storage rooms more than 100 square feet in area	1 hour and automatic fire suppression system
Physical plant maintenance shop and workshop	1 hour and automatic fire suppression system
Use Group I-2:	
Gift/retail shops and laboratories employing hazardous quantities less than those which cause classification as Use Group H	1 hour; or automatic fire suppression system with smoke partitions
Use Group I-3 padded cells	1 hour and automatic fire system

Note a. For requirements for fireresistance rated separations and smoke partitions see 780 CMR 302.1.1.1.

Note b. 1 square foot = 0.093 m^2.

302.1.1.1 Separation: Where Table 302.1.1 requires a fireresistance rated separation, the specific occupancy area shall be separated from the remainder of the building with *fire separation assemblies* (see 780 CMR 709.0). Where Table 302.1.1 requires smoke partitions, the smoke partitions shall be constructed of materials consistent with the type of construction and shall be capable of resisting the passage of smoke. The smoke partitions shall extend from the floor to the underside of the fireresistance rated floor/ceiling or roof/ceiling assembly or to the underside of the floor or roof deck above. All doors shall be self-closing or automatic-closing upon detection of smoke.

302.1.2 Accessory areas: Except for accessory areas of Use Group H in accordance with 780 CMR 302.1.2.1 and specific occupancy areas indicated in 780 CMR 302.1.1, where the area devoted to an accessory occupancy does not occupy more than 10% of any *fire area* nor more than 10% of the allowable area permitted by 780 CMR 503.0 based on the accessory use group, a *fire separation assembly* shall not be required between the main use group and accessory areas. The required type of construction and the automatic fire suppression requirements in 780 CMR 904.0 shall be based on the main use group of the *fire area*.

302.1.2.1 High-hazard uses: In buildings that are three stories or less in *height* and equipped throughout with an automatic suppression system in accordance with 780 CMR 9, an occupancy in Use Group F or S is permitted to have accessory areas of Use Group H-2, H-3 or H-4, provided that such areas do not occupy more than 10% of any *fire area* nor more than 10% of the allowable area permitted by 780 CMR 503.0 based on the use group of the accessory area. A *fire separation assembly* shall not be required between the F or S use group and the accessory H use group. The maximum quantity of *hazardous materials* within the accessory H use group shall not exceed twice the permitted exempt amount specified in Table 307.8(1) or Table 307.8(2). The required type of construction shall be based on the main use group of the *fire area*.

302.2 Mixed use: All buildings and structures that include more than one use group shall be further designated as a mixed use and shall comply with 780 CMR 313.0. Specific occupancy areas and accessory areas complying with 780 CMR 302.1.1 and 302.1.2, respectively, shall be classified in accordance with the main use group.

780 CMR 303.0 ASSEMBLY USE GROUPS

303.1 General: All structures which are designed or occupied for the gathering together of persons for purposes such as civic, social or religious functions, recreation, food or drink consumption or awaiting transportation, shall be classified as Use Group A-1, A-2, A-3, A-4 or A-5. A room or space used for assembly purposes by less than 50 persons and which is accessory to another use group shall be included as a part of that main use group. Other buildings or structures which accomodate less than 50 but would otherwise qualify as places of assembly, shall be classified in Use Group B. The term "Use Group A" shall include Use Groups A-1, A-2, A-3, A-4 and A-5.

303.2 Use Group A-1, theaters: This use group shall include all theaters and all other buildings and structures intended for the production and viewing of performing arts or motion pictures; and which are usually provided with fixed seats-including theaters, motion picture theaters and television and radio studios admitting an audience. *Stages* and *platforms* shall comply with 780 CMR 412.0.

303.3 Use Group A-2 structures: This use group shall include all buildings and places of public assembly, without theatrical *stage* accessories, designed for occupancy as dance halls, nightclubs and for similar purposes, including all rooms, lobbies and other spaces connected thereto with a common *means of egress* and entrance.

303.4 Use Group A-3 structures: This use group shall include all buildings with or without an auditorium in which persons assemble for amusement, entertainment or recreation purposes as well as incidental motion picture, dramatic or theatrical presentations, lectures or other similar purposes without theatrical *stage* other than a raised *platform*; and which are principally occupied without permanent seating facilities, including art galleries, exhibition halls, museums, lecture halls, libraries, restaurants other than nightclubs, and recreation centers; and buildings designed for similar assembly purposes, including passenger terminals.

303.5 Use Group A-4 structures: This use group shall include all buildings and structures which are occupied exclusively for the purpose of worship or other religious services.

303.6 Use Group A-5, outdoor assembly: This use group shall include structures utilized for outdoor assembly intended for participation in or reviewing activities, including *grandstands* (780 CMR 1013.0), *bleachers* (780 CMR 1013.0), coliseums, stadiums, amusement park structures (780 CMR 413.0) and fair or carnival structures. Such structures shall comply with all pertinent provisions of 780 CMR.

780 CMR 304.0 BUSINESS USE GROUP

304.1 General: All buildings and structures which are occupied for the transaction of business, for the rendering of professional services, or for other services that involve stocks of goods, wares or merchandise in limited quantities which are incidental to office occupancies or sample purposes, shall be classified as Use Group B. (Also see 780 CMR 303.1.)

304.2 List of business occupancies: The occupancies listed in Table 304.2 are indicative of and shall be classified as Use Group B.

Table 304.2
BUSINESS OCCUPANCIES

- Airport traffic control towers
- Animal hospitals, kennels, pounds
- Automobile and other motor vehicle showrooms
- Banks
- Barber shops
- Beauty shops
- Car wash
- Civic administration
- Clinic, outpatient
- Dry-cleaning; pickup and delivery stations and self-service
- Electronic data processing
- Fire stations
- Florists and nurseries
- Laboratories; testing and research
- Laundries; pickup and delivery stations and self-service
- Police stations
- Post offices
- Print shops
- Professional services; attorney, dentist, physician, engineer, etc.
- Radio and television stations
- Telecommunications equipment building

780 CMR 305.0 EDUCATIONAL USE GROUP

305.1 General: All structures other than those occupied for business training or vocational training, which accommodate more than five persons for educational purposes through the 12th grade, shall be classified as Use Group E.

Exception: A room or space occupied for educational purposes by less than 50 persons, five years of age or more, and which is accessory to another use group shall be classified as a part of the main use group.

305.1.1 Day care facilities: ***A child day care center which provides care for children more than two years nine months shall be classified as use Group E.***

305.2 Business or vocational training: Structures occupied for business training or vocational training shall be classified in the same use group as the business or vocation taught.

780 CMR 306.0 FACTORY AND INDUSTRIAL USE GROUPS

306.1 General: All structures in which occupants are engaged in work or labor in the fabricating, assembling or processing of products or materials, shall be classified as Use Group F-1 or F-2. This includes, among others, factories, assembling plants, industrial laboratories and all other industrial and manufacturing occupancies. The term "Use Group F" shall include Use Groups F-1 and F-2.

306.2 Use Group F-1 structures: Factory and industrial occupancies which are not otherwise classified as low-hazard, Use Group F-2, shall be classified as a moderate-hazard factory and industrial occupancy, Use Group F-1. The manufacturing processes listed in Table 306.2 are indicative of and shall be classified as Use Group F-1.

Table 306.2
MODERATE-HAZARD FACTORY AND INDUSTRIAL OCCUPANCIES

- Aircraft
- Appliances
- Athletic equipment
- Automobiles and other motor vehicles
- Bakeries
- Beverages, alcoholic
- Bicycles
- Boat building
- Boiler works
- Brooms or brushes
- Business machines
- Cameras and photo equipment
- Canneries, including food products
- Clothing
- Condensed and powdered milk manufacture
- Construction and agricultural machinery
- Disinfectants
- Dry cleaning using other than flammable liquids in cleaning or dyeing operations or other than classified in 780 CMR 307.0
- Electric light plants and power houses
- Electrolytic reducing works
- Electronics
- Engines, including rebuilding
- Film, photographic
- Food processing
- Furniture
- Hemp and jute products
- Laundries
- Leather and tanneries, excluding enameling or japanning
- Machinery
- Millwork and woodworking, wood distillation
- Motion picture and television filming
- Musical instruments
- Optical goods
- Paper mills or products
- Plastic products
- Printing or publishing
- Recreational vehicles
- Refuse incinerators
- Shoes
- Soaps and detergents
- Sugar refineries
- Textile mills, including canvas, cotton, cloth, bagging, burlap, carpets and rags
- Tobacco
- Trailers
- Upholstery and manufacturing shops

306.3 Use Group F-2 structures: Factory and industrial occupancies which involve the fabrication or manufacturing of noncombustible materials that, during finishing, packing or processing, do not contribute to a significant fire hazard, shall be classified as Use Group F-2. The manufacturing processes listed in Table 306.3 are indicative of and shall be classified as Use Group F-2.

Table 306.3
LOW-HAZARD FACTORY AND INDUSTRIAL OCCUPANCIES

- Beverages, nonalcoholic
- Brick and masonry
- Ceramic products
- Foundries
- Glass products
- Gypsum
- Ice
- Metal fabrication and assembly
- Water pumping plants

780 CMR 307.0 HIGH-HAZARD USE GROUPS

307.1 General: All structures which are occupied for the manufacturing, processing, generation, storage or other use of *hazardous materials* in excess of the exempt quantities specified in 780 CMR 307.8 shall be classified as Use Group H-1, H-2, H-3 or H-4 in accordance with the hazards presented by each material as described in 780 CMR 307.3 through 307.6. The term "Use Group H" shall include Use Groups H-1, H-2, H-3 and H-4.

307.1.1 Information required: Separate floor plans shall be submitted for buildings and structures with an occupancy in Use Group H, identifying the locations of anticipated contents and processes so as to reflect the nature of each occupied portion of every building and structure. A report identifying all *hazardous materials* including, but not limited to, materials of Use Group H to be stored or utilized, shall be submitted and the methods of protection from such hazards shall be indicated on the *construction documents*.

307.2 Definitions: The following words and terms shall, for the purposes of 780 CMR 3 and as used elsewhere in 780 CMR, have the meanings shown herein.

Aerosol: A product that is dispensed from an *aerosol* container by a propellant.

Aerosol container: Metal cans, glass or plastic bottles designed to dispense an aerosol. Metal cans shall be limited to a maximum size of 33.8 fluid ounces (1000 ml). Glass or plastic bottles shall be limited to a maximum size of four fluid ounces (118 ml).

Barricade: A structure that consists of a combination of walls, floor and roof, which is designed to withstand the rapid release of energy in an explosion and which is fully confined, partially vented or fully vented; or other effective method of shielding from *explosive* materials by a natural or artificial barrier.

Boiling point: The temperature at which the vapor pressure of a liquid equals the atmospheric pressure of 14.7 pounds per square inch (psia) or 760 mm of mercury. Where an accurate *boiling point* is unavailable for the material in question, or for mixtures which do not have a constant *boiling point*, for the purposes of this classification, the 10% of a distillation performed in accordance with ASTM D86 listed in *Appendix A* shall be used as the *boiling point* of the liquid.

Closed system: The use of a solid or liquid hazardous material in a closed vessel or system that remains closed during normal operations where vapors emitted by the product are not liberated outside of the vessel or system and the product is not exposed to the atmosphere during normal operations; and all uses of *compressed gases*. Examples of closed systems for solids and liquids include product conveyed through a piping system into a closed vessel, system or piece of equipment.

Combustible dusts: Dusts and any similar solid material sufficiently comminuted for suspension in still air which, when so suspended, is capable of self-sustained combustion.

Combustible fibers: Includes readily ignitable and free-burning fibers such as cotton, sisal, henequen, jute, hemp, tow, cocoa fiber, oakum, baled waste, baled wastepaper, kapok, hay, straw, excelsior, Spanish moss and other like material.

Combustible liquids: Any liquids having a *flash point* at or above 100°F (38°C) shall be known as Class II or III liquids. Combustible liquids shall be divided into the following classifications:

Class II: Liquids having *flash points* at or above 100°F (38°C) and below 140°F (60°C).

Class IIIA: Liquids having *flash points* at or above 140°F (60°C) and below 200°F (93°C).

Class IIIB: Liquids having *flash points* at or above 200°F (93°C).

Compressed gas: A gas or mixture of gases as contained having an absolute pressure exceeding 40 psi at 70°F (276 kPa at 21°C) or, regardless of the pressure at 70°F (21°C), having an absolute pressure exceeding 140 psi at 130°F (965 kPa at 54°C); or any liquid material having a vapor pressure exceeding 40 psi absolute at 100°F (276 kPa at 38°C) as determined by ASTM D323 listed in *Appendix A*

Control area: Spaces within a building which are enclosed and bounded by exterior walls, *fire walls*, *fire separation assemblies* and roofs, or a combination thereof, where quantities of *hazardous materials* not exceeding the exempt amounts are stored, dispensed, used or handled.

Corrosive: A chemical that causes visible destruction of, or irreversible alterations in, living tissue at the point of contact. A chemical shall be considered a corrosive if, when tested on the intact skin of albino rabbits by the test method described by DOTn 49 CFR; Part 173 listed in *Appendix A*, such chemical destroys or changes irreversibly the structure of the tissue at the point of contact following an exposure period of four hours. This term shall not refer to action on inanimate surface.

Cryogenic liquids (flammable or oxidizing): Any liquid that has a *boiling point* below -200°F (-129°C).

Deflagration: An exothermic reaction, such as the extremely rapid oxidation of a *flammable* dust or vapor in air, in which the reaction progresses through the unburned material at a rate less than the velocity of sound. A deflagration can have an explosive effect.

Detached storage building: A separate single-story building, without a *basement* or crawl space, used for the storage of *hazardous materials* and located an approved distance from all structures.

Detonation: An exothermic reaction characterized by the presence of a shock wave in the material which establishes and maintains the reaction. The reaction zone progresses through the material at a rate greater than the velocity of sound. The principal heating mechanism is one of shock compression. *detonation*s have an explosive effect.

Dispensing: The pouring or transferring of any material from a container, tank or similar vessel, whereby vapors, dusts, fumes, mists or gases are liberated to the atmosphere.

Explosive: Any chemical compound, mixture or device, the primary or common purpose of which is to function by explosion. The term includes, but is not limited to, dynamite, black powder, pellet powder, initiating explosives, detonators, safety fuses, squibs, detonating cord, igniter cord and igniters.

The term "explosive" includes any material determined to be within the scope of USC Title 18; Chapter 40 listed in ***Appendix A*** and also includes any material classified as an explosive by the Hazardous Material Regulations of DOTn 49 CFR listed in ***Appendix A***.

Flammable: Capable of being readily ignited from common sources of heat or at a temperature of 600°F (316°C) or less.

Flammable compressed-gas: Either a mixture of 13% or less (by volume) with air forms a *flammable* mixture, or the *flammable* range with air is wider than 12%, regardless of the lower limitation. These limitations shall be determined at atmospheric temperature and pressure.

Flammable liquids: Any liquid that has a *flash point* below 100°F (38°C), and has a vapor pressure not exceeding 40 psia (276 kPa) at 100°F (38°C). Flammable liquids shall be known as Class I liquids and shall be divided into the following classifications:

Class IA: Liquids having a flashpoint below 73°F (23°C) and having a *boiling point* below 100°F (38°C).

Class IB: Liquids having a *flash point* below 73°F (23°C) and having a *boiling point* at or above 100°F. (38°C).

Class IC: Liquids having a *flash point* at or above 73°F (23°C) and below 100°F (38 °C).

Flammable solid: A solid, other than a blasting agent or explosive, that is capable of causing fire through friction, absorption of moisture, spontaneous chemical change, or retained heat from manufacturing or processing. or which has an ignition temperature below 212°F (100°C) or which burns so vigorously and persistently when ignited as to create a serious hazard. A chemical shall be considered a flammable solid as determined in accordance with the test method of CPSC 16 CFR; Part 1500.44 listed in ***Appendix A***, if it ignites and burns with a self-sustained flame at a rate greater than 0.1 inch (3 mm) per second along its major axis.

Flash point: The minimum temperature in degrees Fahrenheit at which a *flammable liquid* will give off sufficient vapors to form an ignitable mixture with air near the surface or in the container, but will not sustain combustion. The *flash point* of a liquid shall be determined by appropriate test procedure and apparatus as specified in ASTM D56 and ASTM D93 listed in ***Appendix A***.

Hazardous materials: Those chemicals or substances which are *physical hazards* or *health hazards* as defined and classified in 780 CMR 3 and the fire prevention code listed in ***Appendix A***, whether the materials are in usable or waste condition.

Health hazard: A classification of a chemical for which there is statistically significant evidence that acute or chronic health effects are capable of occurring in exposed persons. The term "health hazard" includes chemicals which are carcinogens, *toxic* or *highly toxic* agents, reproductive toxins, *irritants, corrosives, sensitizers,* hepatotoxins, nephrotoxins, neurotoxins, agents which are capable of acting on the hematopoietic system, and agents which damage the lungs, skin, eyes or mucous membranes.

Highly toxic: A chemical falling within any of the following categories is considered highly toxic.

1. A chemical that has a median lethal dose (LD_{50}) of 50 milligrams or less per kilogram of

body weight when administered orally to albino rats weighing between 200 and 300 grams each.

2. A chemical that has a median lethal dose (LD_{50}) of 200 milligrams or less per kilogram of body weight when administered by continuous contact for 24 hours (or less if death occurs within 24 hours) with the bare skin of albino rabbits weighing between two and three kilograms each.
3. A chemical that has a median lethal concentration (LC_{50}) in air of 200 parts per million by volume or less of gas or vapor, or two milligrams per liter or less of mist, fume or dust, when administered by continuous inhalation for one hour (or less if death occurs within one hour) to albino rats weighing between 200 and 300 grams each.

Incompatible materials: Materials which, when mixed, have the potential to react in a manner that generates heat, fumes, gases or by-products which are hazardous to life or property.

Irritant: A chemical, which is not *corrosive*, but which causes a reversible inflammatory effect on living tissue by chemical action at the point of contact. A chemical shall be considered an irritant if, when tested on the intact skin of albino rabbits by the test method of CPSC 16 CFR; Part 1500.41 listed in ***Appendix A*** for four hours exposure, it results in an empirical score of five or more. A chemical is an eye irritant if so determined by the procedure in CPSC 16 CFR; Part 1500.42 listed in ***Appendix A***.

Open system: The use of a solid or liquid *hazardous material* in a vessel or system that is continuously open to the atmosphere during normal operations and where vapors are liberated, or the product is exposed to the atmosphere during normal operations. Examples of open systems for solids and liquids include dispensing from or into open beakers or containers, dip tank and plating tank operations.

Organic peroxide: An organic compound that contains the bivalent double-bonded oxygen structure and which is considered to be a structural derivative of hydrogen peroxide where one or both of the hydrogen atoms have been replaced by an organic radical.

Unclassified detonable: Organic peroxides which are capable of *detonation*. These peroxides present an extremely high explosion hazard through rapid explosive decomposition.

Class I: Class I organic peroxides are capable of *deflagration*, but not *detonation*. These peroxides present a high explosion hazard through rapid decomposition.

Class II: Class II organic peroxides burn very rapidly and present a severe reactivity hazard.

Class III: Class III organic peroxides burn rapidly and present a moderate reactivity hazard.

Oxidizer: A chemical other than a blasting agent or *explosive* that initiates or promotes combustion in other materials, thereby causing fire either of itself or through the release of oxygen or other gases.

Class 4: An *oxidizer* that can undergo an explosive reaction due to contamination or exposure to thermal or physical shock. Additionally, the oxidizer will enhance the burning rate and is capable of causing spontaneous ignition of combustibles.

Class 3: An *oxidizer* that will cause a severe increase in the burning rate of combustible materials with which the oxidizer comes in contact or that will undergo vigorous self-sustained decomposition due to contamination or exposure to heat.

Class 2: An *oxidizer* that will cause a moderate increase in the burning rate or that is capable of causing spontaneous ignition of combustible materials with which the *oxidizer* comes in contact.

Class 1: An *oxidizer* whose primary hazard is a slight increase in the burning rate but which does not cause spontaneous ignition when the oxidizer comes in contact with combustible material.

Physical hazard: A chemical for which there is evidence in the referenced standards listed in ***Appendix A*** that it is a *combustible liquid, compressed gas, cryogenic, explosive, flammable gas, flammable liquid, flammable solid, organic peroxide, oxidizer, pyrophoric or unstable (reactive) or water-reactive material*.

Pyrophoric: A material that will spontaneously ignite in air at or below a temperature of 130°F (54°C).

Radioactive material: Any material or combination of material that spontaneously emits ionizing radiation.

Sensitizer: A chemical that causes a substantial proportion of exposed people or animals to develop an allergic reaction in normal tissue after repeated exposure to the chemical.

Tires, bulk storage of: Storage of 10,000 or more average-sized passenger vehicle tires weighing approximately 25 pounds (11 kg) each (see 780 CMR 307.5).

Toxic: A chemical that is within any of the following categories shall be considered toxic:

1. A chemical that has a median lethal dose

(LD_{50}) of more than 50 milligrams per kilogram but not more than 500 milligrams per kilogram of body weight when administered orally to albino rats weighing between 200 and 300 grams each.

2. A chemical that has a median lethal dose (LD_{50}) of more than 200 milligrams per kilogram but not more than 1,000 milligrams per kilogram of body weight when administered by continuous contact for 24 hours (or less if death occurs within 24 hours) with the bare skin of albino rabbits weighing between two and three kilograms each.
3. A chemical that has a median lethal concentration (LC_{50}) in air of more than 200 parts per million but not more than 2,000 parts per million by volume of gas or vapor, or more than two milligrams per liter but not more than 20 milligrams per liter of mist, fume or dust, when administered by continuous inhalation for one hour (or less if death occurs within I hour) to albino rats weighing between 200 and 300 grams each.

Unstable (reactive) material: A material which, in the pure state or as commercially produced, will vigorously polymerize, decompose or condense, become self-reactive, or otherwise undergo a violent chemical change under conditions of shock, pressure or temperature.

Class 4: Materials that in themselves are readily capable of *detonation* or explosive decomposition or explosive reaction at normal temperatures and pressures. This class includes, among others, materials that are sensitive to localized thermal or mechanical shock at normal temperatures and pressures.

Class 3: Materials that in themselves are capable of *detonation* or explosive decomposition or explosive reaction, but that require a strong initiating source or that must be heated under confinement before initiation. This class includes, among others, materials that are sensitive to thermal or mechanical shock at elevated temperatures and pressures.

Class 2: Materials that readily undergo violent chemical change at elevated temperatures and pressures. This class includes, among others, materials that exhibit an exotherm at temperatures less than or equal to 150°C when tested by differential scanning calorimetry.

Class 1: Materials that in themselves are normally stable, but that can become unstable at elevated temperatures and pressures. This class includes, among others, materials that change or decompose on exposure to air, light or moisture, and materials that exhibit an exotherm at temperatures greater than 150°C, but less than or equal to 300°C, when tested by differential scanning calorimetry.

Water-reactive materials: A chemical that reacts with water to release a gas that is either *flammable* or presents a *health hazard.*

Class 3: Materials which react explosively with water without requiring heat or confinement.

Class 2: Materials which are capable of forming potentially explosive mixtures with water.

307.3 Use Group H-1 structures: All buildings and structures which contain materials that present a *detonation* hazard, shall be classified as Use Group H- 1. Such materials shall include but are not limited to:

Explosives
Organic Peroxides, unclassified detonable
Oxidizers, Class 4
Unstable (reactive) materials, Class 3 detonable, and Class 4
Detonable *pyrophoric* materials

307.4 Use Group H-2 structures: All buildings and structures which contain materials that present a *deflagration* hazard or a hazard from accelerated burning, shall be classified as Use Group H-2. Such materials shall include but are not limited to:

Combustible dusts
Combustible liquids, Class II and Class IIIA
Cryogenic liquids, flammable or oxidizing
Flammable gases
Flammable liquids
Organic peroxides, Class I and Class II
Oxidizers, Class 3
Oxidizing gases
Pyrophoric liquids, solids and gases, nondetonable
Unstable (reactive) materials, Class 3, nondetonable

307.5 Use Group H-3 structures: All buildings and structures which contain materials that readily support combustion or present a *physical hazard*, shall be classified as Use Group H-3. Such materials shall include but are not limited to:

Aerosols, except that Level 1 *aerosols* defined in the fire prevention code listed in *Appendix A* shall be classified as Use Group S-1 or F-1
Combustible fibers
Combustible liquids, Class IIIB
Flammable solids
Organic peroxides, Class III
Oxidizers, Class 1 and Class 2
Tires, bulk storage of
Unstable (reactive) materials, Class 1 and Class 2
Water-reactive materials, Class 2 and Class 3

307.6 Use Group H-4 structures: All buildings and structures which contain materials that are health hazards, shall be classified as Use Group H-4. Such materials shall include but are not limited to:

Corrosives
Highly toxic materials
Irritants

Radioactive materials
Sensitizers
Toxic materials

307.7 Multiple hazards: All buildings and structures containing a material or materials representing hazards that are classified in one or more of Use Groups H-1, H-2, H-3 and H-4, shall conform to the code requirements for each of the use groups so classified.

307.8 Exceptions: The following shall not be classified in Use Group H, but shall be classified in the use group which they most nearly resemble. High-hazard materials of any quantity shall conform to the requirements of 780 CMR, including 780 CMR 417.0, and the fire prevention code listed in *Appendix A*.

1. All buildings and structures which contain not more than the exempt quantities of high-hazard materials as shown in Tables 307 .8(1) and 307.8(2) provided that such buildings are maintained in accordance with the fire prevention code listed in *Appendix A*.
2. Buildings utilizing *control areas* in accordance with 780 CMR 417.2 which contain not more than the exempt quantities of high-hazard materials as shown in Tables 307.8(1) and 307.8(2).
3. Buildings and structures occupied for the storage of 10,000 or less vehicle tires weighing approximately 25 pounds (11 kg) each, provided that such buildings are equipped throughout with an *automatic sprinkler system* in accordance with 780 CMR 906.2.1.
4. Buildings and structures occupied for the application of *flammable* finishes, provided that such buildings or areas conform to the requirements of 780 CMR 419.0 and NFiPA 33, NFiPA 34 and the fire prevention code listed in *Appendix A*.
5. Rooms containing *flammable liquids* in tightly closed containers of 1-gallon capacity (0.0038 m) or less for retail sale or private utilization on the premises and in quantities not exceeding two gallons per square foot (0.082 m^3/m^2) of room area.
6. Retail paint salesrooms with quantities of paint not exceeding two-gallons per square foot (0.082 m^3/m^2) of room area.
7. *Closed systems* housing *flammable* or *combustible liquids* or gases utilized for the operation of machinery or equipment.
8. Cleaning establishments which utilize *combustible liquid* solvents having a *flash point* of 140°F (60°C) or higher in *closed systems* employing equipment listed by an *approved testing agency*, provided that this occupancy is separated from all other areas of the building by one-hour fireresistance rated *fire separation assemblies*.
9. Cleaning establishments which utilize a liquid solvent having a *flash point* at or above 200°F (93°C).
10. Liquor stores and distributors without bulk storage.
11. Refrigeration systems.
12. The storage or utilization of materials for agricultural purposes on the premises.
13. Stationary batteries utilized for facility emergency power, uninterrupted power supply or telecommunication facilities provided that the batteries are provided with safety venting caps and *ventilation* is provided in accordance with the mechanical code listed in *Appendix A*.
14. *Corrosives, irritants* and *sensitizers* shall not include personal or household products in their original packaging used in retail display or commonly used building materials.
15. Buildings and structures occupied for *aerosol* manufacturing or storage shall be classified as Use Group F-1 or S-1, provided that such buildings conform to the requirements of NFiPA 30 and the fire prevention code listed in *Appendix A*.

780 CMR 308.0 INSTITUTIONAL USE GROUPS

308.1 General: All structures in which people suffering from physical limitations because of health or age are harbored for medical or other care or treatment, or in which people are detained for penal or correction purposes, or in which the liberty of the inmates is restricted, shall be classified as Use Group I-1, I-2 or I-3. The term "Use Group I" shall include Use Groups I-1, I-2 and I-3.

308.2 Use Group I-1: ***Except as modified by the provisions of 780 CMR 4, Special Use and Occupancy***, this use group shall include buildings and structures which house six or more individuals who, because of age, mental disability or other reasons, must live in a supervised environment but who are physically capable of responding to an emergency situation without personal assistance. ***Except as specified otherwise by the requirements of 780 CMR 4, Special Use and Occupancy,*** where accommodating persons of the above description, the following types of facilities shall be classified as I-1 facilities, board and care facilities, half-way houses, group homes, social rehabilitation facilities, alcohol and drug centers and convalescent facilities. A facility such as the above with five or less occupants shall be classified as a residential use group.

308.3 Use Group I-2: This use group shall include buildings and structures used for medical, surgical, psychiatric, nursing or custodial care on a 24-hour basis of six or more persons who are not capable of self-preservation. Where accommodating persons of the above description, the following types of facilities shall be classified as I-2 facilities: hospitals, nursing homes (both intermediate care facilities and skilled nursing facilities), mental hospitals and detoxification facilities. A facility such as the above with five or less occupants shall be classified as a residential use group.

308.3.1 Child care facility: ***A child day care center which accommodates children two years nine months of age or less shall be classified as Use Group I-2.***

308.4 Use Group I-3: This use group shall include buildings and structures which are inhabited by six or more persons who are under some restraint or security. An I-3 facility is occupied by persons who are generally incapable of self-preservation due to security measures not under the occupants' control. Where accommodating persons of the above description, the following types of facilities shall be classified as I-3 facilities: prisons, jails, reformatories, detention centers, correctional centers and prerelease centers. Buildings of Use Group I-3 shall be classified as one of the occupancy conditions indicated in 780 CMR 308.4.1 through 308.4.5 (see 780 CMR 410.0).

308.4.1 Occupancy Condition I: This occupancy condition shall include all buildings in which free movement is allowed from sleeping areas, and other spaces where access or occupancy is permitted, to the exterior via *means of egress* without restraint. An Occupancy Condition I facility shall be classified as Use Group R.

308.4.2 Occupancy Condition II: This occupancy condition shall include all buildings in which free movement is allowed from sleeping areas and any other occupied *smoke compartment* to one or more other *smoke compartments*. Egress to the exterior is impeded by locked *exits*.

308.4.3 Occupancy Condition III: This occupancy condition shall include all buildings in which free movement is allowed within individual *smoke compartments*, such as within a residential unit comprised of individual sleeping rooms and group activity spaces, where egress is impeded by remote-controlled release of *means of egress* from such *smoke compartment* to another *smoke compartment*

Table 307.8(1)
EXEMPT AMOUNTS OF HAZARDOUS MATERIALS, LIQUIDS AND CHEMICALS PRESENTING A PHYSICAL HAZARD MAXIMUM QUANTITIES PER CONTROL AREA[a,k]

Material	Class	Use Groups	Storage[b]			Closed systems[b]			Open systems[b]	
			solid pounds (cubic feet)	liquid gallons (pounds)	gas (Cubic feet)	Solid pounds (cubic feet)	Liquid gallons (pounds)	Gas cubic feet	Solid pounds (cubic feet)	liquid gallons (pounds)
Combustible[c] liquid	II IIIA IIIB	H-2 H-2 H-3	NA	$120^{d,e}$ $330^{d,e}$ $13,200^{e,f}$	NA	NA	120^{d} 330^{d} $13,200^{f}$	NA	NA	30^{d} 80^{d} $3,300^{f}$
Conbustible dust pounds per 1,00 feet		H-2	1^{g}	NA	NA	1^{g}	NA	NA	1^{g}	NA
Combustible fiber	loose Baled	H-3	(100) (1,000)	NA	NA	(100) (1,000)	NA	NA	(20) (200)	NA
Cryogenics, flammible or oxidizing		H-2	NA	45^{d}	NA	NA	45^{d}	NA	NA	10^{d}
Explosives		H-1	$1^{e,h,i}$	$(1)^{e,h,i}$	NA	¼^{h}	(¼)^{h}	NA	¼^{h}	(¼)^{h}
Flammable gas	Gaseous Liquified	H-2	NA	NA $30^{d,e}$	$1,000^{d,e}$ NA	NA	NA $30^{d,e}$	$750^{d,e}$ NA	NA	NA
Flammible liquid[c]	IA IB IC	H-2	NA	$30^{d,e}$ $60^{d,e}$ $90^{d,e}$	NA	NA	30^{d} 60^{d} 90^{d}	NA	NA	10^{d} 15^{d} 20^{d}
Combination (IA, IB, IC)		H-2	NA	$120^{d,e,j}$	NA	NA	$120^{d,j}$	NA	NA	$30^{d,j}$
Flammible solid		H-2	$125^{d,e}$	NA	NA	25^{d}	NA	NA	25^{d}	NA
Organic peroxide	UD I II III	H-1 H-2 H-3 H-3	$1^{e,h}$ $5^{d,e}$ $50^{d,e}$ $125^{d,e}$	$(1)^{e,h}$ $(5)^{d,e}$ $(50)^{d,e}$ $(125)^{d,e}$	NA	¼^{h} 1^{d} 50^{d} 125^{d}	(¼)^{h} $(1)^{d}$ $(50)^{d}$ $(125)^{d}$	NA	¼^{h} 1^{d} 10^{d} 25^{d}	(¼)^{h} $(1)^{d}$ $(10)^{d}$ $(25)^{d}$
Oxidizer	4 3 2 1	H-1 H-2 H-3 H-3	$1^{e,h}$ $10^{d,e}$ $250^{d,e}$ $1,000^{d,e}$	$(1)^{e,h}$ $(10)^{d,e}$ $(250)^{d,e}$ $(1,000)^{d,e}$	NA	¼^{h} 2^{d} 250^{d} $1,000^{d}$	(¼)^{h} $(2)^{d}$ $(250)^{d}$ $(1,000)^{d}$	NA	¼^{h} 2^{d} 50^{d} 200^{d}	(¼)^{h} $(2)^{d}$ $(50)^{d}$ $(200)^{d}$
Oxidizer - gas	Gaseous Liquified	H-2	NA	NA $15^{d,e}$	$1,500^{d,e}$ NA	NA	NA $(15)^{d,e}$	$1,500^{d,e}$ NA	NA	NA
Pyrophoric		H-2	$4^{e,h}$	$(4)^{e,h}$	$50^{e,h}$	1^{h}	$(1)^{h}$	$10^{e,h}$	0	0
Unstable (reactive)	4 3 2 1	H-1 H-1 or H-2 H-3 H-3	$1^{e,h}$ $5^{d,e}$ $50^{d,e}$ $125^{d,e}$	$(1)^{e,h}$ $(5)^{d,e}$ $(50)^{d,e}$ $(125)^{d,e}$	$10^{d,h}$ $50^{d,e}$ $250^{d,e}$ $750^{d,e}$	¼^{h} 1^{d} 50^{d} 125^{f}	(¼)^{h} $(1)^{d}$ $(50)^{d}$ $(125)^{f}$	$2^{e,h}$ $10^{d,e}$ $250^{d,e}$ $750^{d,e}$	¼^{h} 1^{d} 10^{d} 25^{f}	(¼)^{h} $(1)^{d}$ $(10)^{d}$ $(25)^{f}$
Water reactive	3 2	H-3 H-3	$5^{d,e}$ $50^{d,e}$	$(5)^{d,e}$ $(50)^{d,e}$	NA	5^{d} 50^{d}	$(5)^{d}$ $(50)^{d}$	NA	1^{d} 10^{d}	$(1)^{d}$ $(10)^{d}$

Note a. For use of control areas, see 780 CMR 417.2

Note b. The aggregate quantity in utilization and storage shall not exceed the quantity listed for storage.

Note c. The quantities of alcoholic beverages in retail sales occupancies shall not be limited provided the liquids are packaged in individual containers not exceeding 1 gallon. In retail sales and storage occupancies, the quantities of medicines, foodstuffs and cosmetics, containing not more than 50% by volume of water-miscible liquids and with the remainder of the solutions not being flammable, shall not be limited provided that such materials are packaged in individual containers not exceeding one gallon.

Note d. Maximum quantities shall be increased 100% in buildings equipped throughout with an automatic sprinkler system in accordance with 780 CMR 906.2.1. Where note e. Also applies, the increase for both notes shall be applied accumulatively.

Note e. Quantities shall be increased 100% when stored in approved cabinets, gas cabinets, fume hoods, exhausted enclosures, or safety cans as specified in the fire prevention code listed in ***Appendix A***. Where note d. also applies, the increase for both notes shall be applied accumulatively.

#329

THE COMMONWEALTH OF MASSACHUSETTS
William Francis Galvin
Secretary of the Commonwealth

Regulation Filing *To be completed by filing agency*

CHAPTER NUMBER: 780 CMR 9

CHAPTER TITLE: Fire Protection Systems

AGENCY: Department of Public Safety / Board of Building Regulations and Standards

SUMMARY OF REGULATION: *State the general requirements and purposes of this regulation.*

These Regulations require an entertainment system response, wherein the activation of any fire protection system element will cause immediate illumination of all areas of egress, activation of all house lighting, and cessation of any and all sounds and visual distractions that conflict with the fire protection system; provide cross referencing to additional special alarm notification requirements for A-2 occupancies; preclude automatic fire suppression systems in elevator machine rooms and hoistway/pit enclosures; expand the references in Note (1) of Table 904.9; and make a spelling correction in 914.2.9.

REGULATORY AUTHORITY: c. 802 of the acts of 1972, as amended and MGL c.143 Sections 93-100

AGENCY CONTACT: Robert Anderson PHONE: 617-727-3200

ADDRESS: One Ashburton Plc, Rm 1301, Boston, MA 02108

Compliance with M.G.L. c. 30A

EMERGENCY ADOPTION - *If this regulation is adopted as an emergency, state the nature of the emergency.*

PRIOR NOTIFICATION AND/OR APPROVAL - *If prior notification to and/or approval of the Governor, Legislature or others was required, list each notification, and/or approval and date, including notice to the Local Government Advisory Commission.*

Local Government Notice on 4/21/04 and 10/18/04, respectively

PUBLIC REVIEW- *M.G.L. c. 30A. §§ 2 and/or 3 requires notice of the hearing or comment period be filed with the Secretary of the Commonwealth, published in appropriate newspapers, and set to persons to whom specific notice must be given at least 21 days prior to such hearing or comment period.*

Date of public hearing or comment period: Comment Period thru 6/11/04 and 12/9/04 respectively

FISCAL EFFECT - *Estimate the fiscal effect of the public and private sectors.*

For the first and second year: No estimate available; driven by Task Force on Fire/Bldg. Safety, or c. 304 of the Acts of 2004, or other

For the first five years: No estimate available; driven by Task Force on Fire/Bldg. Safety, or c. 304 of the Acts of 2004, or other

No fiscal effect: No estimate available; driven by Task Force on Fire/Bldg. Safety, or c. 304 of the Acts of 2004, or other

SMALL BUSINESS IMPACT - *State the impact of this regulation on small business. Include a description of reporting, record keeping and other compliance requirements as well as the appropriateness of performance versus design standards and whether this regulation duplicates or conflicts with any other regulation. If the purpose of this regulation is to set rates for the state, this section does not apply.*

No estimate available; driven by Task Force on Fire/Bldg. Safety, or c. 304 of the Acts of 2004, or other

CODE OF MASSACHUSETTS REGULATIONS INDEX - *List key subjects that are relevant to this regulation*:

780 CMR 9, Section 904.1-automatic fire supression systems, exceptions, elevator machine rooms, hoistway/pit enclosures, fireresistance rating; Table 904.9-sprinkler requirements, nightclubs; Section 917.4.8.2-entertainment system response

PROMULGATION - *State the action taken by this regulation and its effect on existing provisions of the Code of Massachusetts Regulations (CMR) to repeal, replace or amend. List by CMR number:*

Amends 780 CMR 9, Section 904.1, Section 904.3.1, Section 904.3.2, Table 904.9, Section 914.2.9, Section 917.4.1.1, Section 917.8.2

ATTESTATION - *The regulation described herein and attached hereto is a true copy of the regulation adopted by this agency.* ATTEST:

SIGNATURE: ______________________ DATE: 8/26/05

Publication - *To be completed by the Regulations Division*

MASSACHUSETTS REGISTER NUMBER: #1034 DATE: 9/9/05

EFFECTIVE DATE: 9/9/05

CODE OF MASSACHUSETTS REGULATIONS

Remove these pages:	*Insert these pages:*
151 - 154	151 - 154
157 - 162	157 - 162

A TRUE COPY ATTEST

William Francis Galvin

WILLIAM FRANCIS GALVIN
SECRETARY OF THE COMMONWEALTH
DATE 8/26/05 CLERK

Note f. The permitted quantities shall not be limited in a building equipped throughout with an automatic sprinkler system in accordance with 780 CMR 906.2.1.

Note g. A dust explosion potential is considered to exist where 1 pound or more of combustible dust per 1,000 cubic feet of volume is normally in suspension or could be put into suspension in all or a portion of an enclosure or inside pieces of equipment. This also includes combustible dust which accumulates on horizontal surface inside buildings or equipment and which could be put into suspension be an accident, sudden force or sudden explosion.

Note h. Permitted only in buildings equipped throughout with an automatic sprinkler system in accordance with 780 CMR 906.2.1.

Note i. One pound of black sporting powder and 20 pounds of smokeless powder are permitted in sprinklered or unsprinklered buildings.

Note j. Containing not more than the exempt amounts of Class I-A, Class I-B or Class I-C flammable liquids.

Note k. Quantities in parenthesis indicate quantity units in parenthesis at the head of each column. 1 cubic foot = $0.028\ m^3$; 1 pound = 0.454 kg; 1 gallon = $0.00379\ m^3$

Table 307.8(2)
EXEMPT AMOUNTS OF HAZARDOUS MATERIALS, LIQUIDS AND CHEMICALS PRESENTING A HEALTH HAZARD
MAXIMUM QUANTITIES PER CONTROL AREA[a,b,h]

Material	Storage[c]			Closed systems[c]			Open systems[c]	
	Solid pounds[d,e]	Liquid gallons (pounds)[d,e]	Gas cubic feet	Solid pounds[d]	Liquid gallons (pounds)[d]	Gas cubic feet	Solid pounds[d]	Liquid gallons (pounds)[d]
Corrosive	5,000	500	810[d,e]	5,000	500	810[d,e]	1,000	100
Highly toxic	1	(1)	20[f]	1	(1)	20[f]	¼	(¼)
Irritant	5,000	500	810[d,e]	5,000	500	810[d,e]	1,000	100
Radioactive[g]	25 rem - unsealed source 100 rem - sealed source			100 rem - sealed source			25 rem - sealed source	
Sensitizer	5,000	500	810[d,e]	5,000	500	810[d,e]	1,000	100
Toxic	500	(500)	810[d,e]	500	(500)	810[d,e]	125	(125)
Other health hazards	5,000	500	810[d,e]	5,000	500	810[d,e]	1,000	100

Note a. For use of control areas, see 780 CMR 417.2

Note b. In retail sales occupancies, the quantities of medicines, foodstuffs and cosmetics, containing not more than 50% by volume of water-miscible liquids and with the remainder of the solutions not being flammable, shall not be limited provided that such materials are packaged in individual containers not exceeding 1 gallon.

Note c. The aggregate quantity in utilization and storage shall not exceed the quantity listed for storage.

Note d. Maximum quantities shall be increased 100% in buildings equipped throughout with an automatic sprinkler system in accordance with 780 CMR 906.2.1. Where note e. also applies, the increase for both notes shall be applied accumulatively.

Note e. Maximum quantities shall be increased 100% when stored in approved storage cabinets, gas cabinets, fume hoods, exhausted enclosures, or safety cans as specified in the fire prevention code listed in *Appendix A*. Where note d. also applies, the increase for both notes shall be applies accumulatively.

Note f. Permitted only when stored in approved exhausted gas cabinets, exhausted enclosures or fume hoods.

Note g. Maximum dosage permitted in any single exposure.

Note h. Quantities in parenthesis indicate quantity units in parenthesis at the head of each column. 1 cubic foot = $0.028\ m^3$; 1 pound = 0.454 kg; 1 gallon = $0.00379\ m^3$

308.4.4 Occupancy Condition IV: This occupancy condition shall include all buildings in which free movement is restricted from an occupied space. Remote-controlled release is provided to permit movement from all sleeping rooms, activity spaces and other occupied areas within the *smoke compartment* to other *smoke compartments*.

308.4.5 Occupancy Condition V: This occupancy condition shall include all buildings in which free movement is restricted from an occupied space. Staff-controlled release is provided to permit movement from all sleeping rooms, activity spaces and other occupied areas within the *smoke compartment* to other *smoke compartments*.

780 CMR 309.0 MERCANTILE USE GROUP

309.1 General: All buildings and structures which are occupied for display and sales purposes involving stocks of goods, wares or merchandise incidental to such purposes and open to the public, shall be classified as Use Group M. This includes, among others, retail stores, automotive service stations, shops, salesrooms and markets. An automotive service station is that portion of a property where motor fuels are stored and dispensed from fixed equipment into the fuel tanks of motor vehicles or approved containers, including any building used for the sale of automotive accessories, or for minor automotive repair work. Minor repairs include the exchange of parts, oil changes, engine tune-ups and similar routine maintenance work. Retail sales of *hazardous materials* shall comply with 780 CMR 307.8 ***or 780 CMR 426, as applicable***.

780 CMR 310.0 RESIDENTIAL USE GROUPS

310.1 General: All structures in which individuals live, or in which sleeping accommodations are provided (with or without dining facilities), excluding those that are classified as institutional occupancies, shall be classified as Use Group R-1, R-2, R-3, R-4 or ***R-5***. The term "Use Group R" shall include Use Groups R-1, R-2 and R-3, R-4 and R-5.

> ***Note: Assisted Living Residences which are certified as such by the Executive Office of Elder Affairs pursuant to M.G.L. c. 19D shall be classified in the residential use group R-1, R-2, R-3 or R-4 as applicable. Portions of an assisted Living Residence which are used for any use other than residential shall be classified in accordance with the intended use.***

310.2 Definitions: The following words and terms shall, for the purposes of 780 CMR 3 and as used elsewhere in 780 CMR, have the meanings shown herein.

Dwellings:

Assisted Living Residence: A residence licensed by the Executive Office of Elder Affairs pursuant to M.G.L. c. 19D.

Boarding house: A building arranged or used for lodging for compensation, with or without meals, and not occupied as a single unit.

Dormitory: A space in a building where group sleeping accommodations are provided in one room, or in a series of closely associated rooms.

Dwelling unit: A single unit providing complete, independent living facilities for one or more persons, including permanent provisions for living, sleeping, eating, cooking and sanitation.

Hotel: Any building containing six or more guest rooms, intended or designed to be used, or which are used, rented or hired out to be occupied or which are occupied for sleeping purposes by guests.

Lodging house: Refer to M.G.L. c. 140, § 22

Motel: A hotel as defined in 780 CMR.

Multiple dwelling: A building or portion thereof containing more than two *dwelling units* and not meeting the requirements for a *multiple single dwelling*.

Multiple single dwelling: A building or portion thereof containing more than two *dwelling units* (see 780 CMR 310.5)

One-family dwelling: A building containing one *dwelling unit* but not a *lodging house* (see M.G.L. c. 140, § 22).

Two-family dwelling: A building containing two *dwelling units* but not *lodging house* (see M.G.L. c. 140, § 22).

310.3 Use Group R-1 structures: This use group shall include all *hotels, motels, boarding houses* and similar buildings arranged for shelter and sleeping accommodations and in which the occupants are primarily transient in nature, occupying the facilities for a period of less than 30 days.

310.4 Use Group R-2 structures: This use group shall include all *multiple dwellings* having more than two *dwelling units*, except as provided for in 780 CMR 310.5 for multiple *single dwelling units*, and shall also include all *boarding houses* and similar buildings arranged for shelter and sleeping accommodations in which the occupants are primarily not transient in nature.

310.4.1 Dormitories: A *dormitory* facility which accommodates more than five persons more than 2½ years of age shall be classified as Use Group R-2.

310.5 Use Group R-3 structures: This use group shall include all buildings arranged for occupancy as *one- or two-family dwellings*, including *multiple single family dwellings* where each unit has two independent *means of egress* not common to any other *dwelling unit*, and where each *dwelling unit* is separated from adjoining dwelling units by two-hour *fire separation assemblies* (see 780 CMR 709.0). Use group R-3 structures are not *lodging houses* (see M.G.L. c. 140, § 22).

Exceptions

1. In *multiple single-family dwellings* that are equipped throughout with an approved *automatic sprinkler system* installed in accordance with 780 CMR 906.2.1 or 906.2.2, the fireresistance rating of the *dwelling unit* separation shall not be less than one hour. *Dwelling unit* separation walls shall be constructed as *fire partitions* (see 780 CMR 711.0).
2. In multiple *single-family dwellings* that are equipped throughout with an approved *automatic sprinkler system* installed in accordance with 780 CMR 906.2.3, a two-hour *fire separation assembly* shall be provided between each pair of *dwelling units*. The fireresistance rating between each *dwelling unit* shall not be less than one hour and shall be constructed as a *fire partition*.

310.5.1*Family day-care home: A family day-care home as defined by M.G.L. c.28A, §. 9, shall be classified as use group R-3 or R-4. Such facility shall not accommodate more than six children.*

310.6 Use Group R-4 structures: This use group shall include all detached *one-* or *two-family dwellings* not more than three stories in *height*, and the *accessory structures.*. All such structures shall be designed in accordance with 780 CMR 36 or in accordance with the requirements of 780 CMR applicable to Use Group R-3.

310.7 Use Group R-5 structures: This use group shall include all buildings arranged for use as limited group residences in accordance with the requirements of 780 CMR (see 780 CMR 4).

780 CMR 311.0 STORAGE USE GROUPS

311.1 General: All structures which are primarily used for the storage of goods, wares or merchandise shall be classified as Use Group S-1 or S-2. This includes, among others, warehouses, storehouses and freight depots. The quantity of *hazardous materials* in storage shall comply with 780 CMR 307.8. The term "Use Group S" shall include Use Groups S-1 and S-2.

311.2 Moderate-hazard storage, Use Group S-1: Buildings occupied for the storage of moderate-hazard contents which are likely to burn with moderate rapidity, but which do not produce either poisonous gases, fumes or *explosives* including, among others, the materials listed in Table 311.2, shall be classified as Use Group S-1. A motor vehicle repair garage is that portion of a property wherein major repairs, such as engine overhauls, painting or body work, are performed on motorized vehicles.

Table 311.2
MODERATE-HAZARD STORAGE OCCUPANCIES

Bags, cloth, burlap and paper
Bamboo and rattan
Baskets
Belting, canvas and leather
Books and papers in rolls and packs
Boots and shoes
Buttons, including cloth covered, pearl or bone
Cardboard and cardboard boxes
Clothing, woolen wearing apparel
Cordage
Furniture
Furs
Glue, mucilage, paste and size
Horn and combs, other than celluloid
Leather, enameling or japanning
Linoleum
Livestock shelters
Lumber yards
Motor vehicle repair garages
Petroleum warehouses for storage of lubricating oils with a flash point of 200°F or higher
Photo engraving
Public garages (Group 1) and stables
Silk
Soap
Sugar
Tobacco, cigars, cigarettes and snuff
Upholstering and mattress manufacturing
Wax candles

311.3 Low-hazard storage, Use Group S-2: Low-hazard storage occupancies shall include buildings occupied for the storage of noncombustible materials, and of low-hazard wares that do not ordinarily burn rapidly such as products on wood pallets or in paper cartons without significant amounts of combustible wrappings, but with a negligible amount of plastic trim such as knobs, handles or film wrapping. Such occupancies shall be classified as Use Group S-2 including, among others, the materials listed in Table 311.3.

Table 311.3
LOW-HAZARD STORAGE OCCUPANCIES

Asbestos
Beer or wine up to 12% alcohol in metal, glass or ceramic containers
Cement in bags
Chalk and crayons
Dairy products in nonwaxed coated paper containers
Dry cell batteries
Electrical coils
Electrical motors
Food products
Foods in noncombustible containers
Fresh fruits and vegetables in nonplastic trays or containers
Frozen foods
Glass
Glass bottles, empty or filled with noncombustible liquids
Gypsum board
Inert pigments
Ivory
Meats
Metal cabinets
Metal desks with plastic tops and trim
Metal parts
Metals
Mirrors
New empty cans
Oil filled and other types of distribution transformers
Open parking structures
Porcelain and pottery
Public garages (Group 2)
Stoves
Talc and soapstone
Washers and dryers

780 CMR 312.0 UTILITY AND MISCELLANEOUS USE GROUP

312.1 General: Buildings and structures of an accessory character and miscellaneous structures not classified in any specific use group shall be constructed, equipped and maintained to conform to the requirements of 780 CMR commensurate with the fire and life hazard incidental to their occupancy. Use Group U shall include fences over six feet (1829 mm) high, tanks, cooling towers, retaining walls and buildings such as *private garages*, carports, sheds and agricultural buildings.

780 CMR 313.0 MIXED USE GROUPS

313.1 Two or more use groups: Where a building is occupied by two or more occupancies not included in the same use group, the building or portion thereof shall comply with 780 CMR 313.1.1, 313.1.2 or 313.1.3 or with combinations of 780 CMR 313.1.1, 313.1.2 and 313.1.3, except that occupancies in Use Group H shall be separated from all other use groups in accordance with 780 CMR 313.1.2 or 313.1.3. Buildings that include an open parking structure located beneath an A, I, B, M or R Use Group shall comply with 780 CMR 313.1.1, 313.1.2, 313.1.3 or 313.2.

Exception: *fire areas* of Use Group H-1 shall be in separate and detached buildings and structures in accordance with 780 CMR 707.1.1.

313.1.1 Nonseparated use groups: Each portion of the building shall be individually classified as to use. The required type of construction for the building shall be determined by applying the *height* and *area* limitations for each of the applicable use groups to the entire building. The most restrictive type of construction, so determined, shall apply. The other requirements of 780 CMR shall apply to each portion of the building based on the use group of that occupancy except that the most restrictive applicable provisions of 780 CMR 403.0 and 780 CMR 9 shall apply to these nonseparated use groups. A *fire separation assembly* is not required between use groups, except as required by other sections of 780 CMR.

313.1.2 Separated use groups: Each portion of the building shall be individually classified in a use group and shall be completely separated from adjacent *fire areas* by fire separation assemblies (see 780 CMR 709.0) and floor/ceiling assemblies (see 780 CMR 713.0) having a fireresistance rating determined in accordance with Table 313.1.2, for the use groups being separated. Each *fire area* shall comply with the code based on the use group of that space. Each *fire area* shall comply with the *height* limitations of 780 CMR 503.0 based on the use of that space and the type of construction classification. In each story, the *building area* shall be such that the sum of the ratios of the floor *area* of each use group divided by the allowable *area* from 780 CMR 503.0 for each use group shall not exceed one.

> **Exception**: Where the building is equipped throughout with an *automatic sprinkler system* in accordance with 780 CMR 906.2.1, the required fireresistance rating of *fire separation assemblies* separating areas of other than Use Group H, shall be reduced from those indicated in Table 313.1.2 by one hour but to not less than one hour and to not less than that required by Table 602 for floor construction.

313.1.3 Separate buildings: Each use group shall be considered a separate building where each such use group is completely separated from adjacent use groups by *fire walls* having a fireresistance rating corresponding to that required by Table 602. Each building shall then comply with the provisions of 780 CMR applicable to the use group of that building.

313.2 Open parking structures beneath other use groups: Open parking structures constructed under Use Groups A, I, B, M and R shall not exceed the *height* and *area* limitations permitted under 780 CMR 406.0. The *height* and *area* of the portion of the building above the open parking structure shall not exceed the limitations in 780 CMR 503.0 for the upper use group. The *height*, in both feet and stories, of the portion of the building above the open parking structure shall be measured from *grade plane* and shall include both the open parking structure and the portion of the building above the parking structure.

Fire separation assemblies between the parking occupancy and the upper occupancy shall correspond to the required fireresistance rating prescribed in Table 313.1.2 for the uses involved. The type of construction shall apply to each occupancy individually, except that all structural members-including main bracing within the open parking structure which is necessary to support the upper occupancy-shall be protected with the more restrictive fire resistive assemblies of the occupancies involved as shown in Table 602. Exit facilities for the upper occupancy shall conform to 780 CMR 10 and shall be separated from the parking area by fire separation walls having at least a two-hour fireresistance rating as required by Table 602 and self-closing *doors* complying with 780 CMR 716.0. *means of egress* from the open parking facility shall comply with 780 CMR 1010.5.

313.3 Use Group R: In buildings of Type 2C, 3B or 5B construction with an occupancy in Use Group R, the first floor shall not be occupied for Use Groups B and M, unless the floor/ceiling assembly and the enclosure walls are protected to afford a one-hour fireresistance rating and the *exits* from the residential floors are separately enclosed in accordance with the requirements of 780 CMR 10.

Table 313.1.2
FIRERESISTANCE RATING REQUIREMENTS FOR FIRE SEPARATION ASSEMBLIES BETWEEN FIRE AREAS[a]

NP- Not Permitted
NA - Not Applicable

Use Group		A-1	A-2	A-3	A-4	A-5	B	E	F-1	F-2	H-1	H-2	H-3	H-4	I-1	I-2	I-3	M	R-1	R-2	R-3	S-1	S-2	U
	A-1	2	3	2	2	2	2	2	2	2	NP	4	3	2	2	3	3	2	2	2	2	2	2	NA
	A-2		3	3	3	3	3	3	3	3	NP	4	3	3	3	3	3	3	3	3	3	3	3	NA
	A-3			2	2	2	2	2	2	2	NP	4	3	2	2	3	3	2	2	2	2	2	2	NA
	A-4				2	2	2	2	2	2	NP	4	3	2	2	3	3	2	2	2	2	2	2	NA
	A-5					NA	2	2	2	2	NP	4	3	2	2	3	3	2	2	2	2	2	2	NA
	B						2	2	2	2	NP	4	3	2	2	3	3	2	2	2	2	2	2	NA
	E							2	2	2	NP	4	3	2	2	3	3	2	2	2	2	2	2	NA
	F-1								2	2	NP	4	3	2	2	3	3	2	2	2	2	2	2	NA
	F-2									2	NP	4	3	2	2	3	3	2	2	2	2	2	2	NA
U	H-1										NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NA
S	H-2											4	4	4	4	4	4	4	4	4	4	4	4	NA
E	H-3												3	3	3	3	3	3	3	3	3	3	3	NA
	H-4													2	2	2	2	2	2	2	2	2	2	NA
G	I-1														2	3	3	2	2	2	2	2	2	NA
R	I-2															3	3	3	3	3	3	3	3	NA
O	I-3																3	3	3	3	3	3	3	NA
U	M																	2	2	2	2	2	2	NA
P	R-1																		2	2	2	2	2	NA
	R-2																			2	2	2	2	NA
	R-3																				2	2	2	NA
	S-1																					2	2	NA
	S-2																						2	NA
	U																							NA

Note a. Fire resistance ratings are expressed in hours.

NON-TEXT PAGE

CHAPTER 4

SPECIAL USE AND OCCUPANCY

780 CMR 401.0 GENERAL

401.1 Scope: In addition to the general requirements of 780 CMR governing the location, construction and equipment of all buildings and structures, and the fireresistance ratings, *height* and *area* limitations of Tables 503 and 602, the provisions of 780 CMR 4 shall control all buildings and structures designed for special occupancies as herein provided.

401.2 Applicable Massachusetts General Law: Applicable Massachusetts General Laws, and applicable rules and regulations, specifically (but not limited to) the referenced portions 310 CMR, 521 CMR, 522 CMR and 527 CMR series as listed in Appendix A shall be adhered to in the design and construction of buildings and and structures subject to the provisions of 780 CMR 4.

780 CMR 402.0 COVERED MALL BUILDINGS

402.1 Scope: The provisions of 780 CMR 402.0 shall apply to buildings or structures defined herein as covered mall buildings not exceeding three floor levels in height at any one point. Except as specifically required by 780 CMR 402.0, covered mall buildings shall meet all applicable provisions of 780 CMR.

Exceptions: Where approved by the code official, the following occupancies are not required to comply with the provisions of 780 CMR 402.0.

1. Foyers and lobbies in occupancies in Use Group B, R-1 or R-2.
2. Buildings which comply totally with all other applicable provisions of 780 CMR.

402.2 Definitions: The following words and terms shall, for the purposes of 780 CMR 402.0 and as used elsewhere in 780 CMR, have the meanings shown herein.

Anchor store: An exterior perimeter department store or major merchandising or magnet center having direct access to a mall and having its required *exits* independent of the mall.

Gross leasable area: The gross leasable area is the total floor area designed exclusively for tenant occupancy. The area of tenant occupancy is measured from the center lines of joint partitions to the outside of the tenant walls.

Mall: A mall is a roofed-over common pedestrian area serving more than one tenant located within a covered mall building.

Mall building, covered: A building enclosing a number of tenants and occupancies such as retail stores, drinking and dining establishments, entertainment and amusement facilities, passenger transportation terminals, offices and other similar occupancies wherein two or more tenants have a main entrance into one or more malls. Anchor stores shall not be considered as part of the covered mall building.

402.3 Lease plan: The *owner or* permit holder shall provide both the building and fire departments with a lease plan showing the locations of each occupancy and its *means of egress* after the certificate of occupancy has been issued. Such plans shall be kept current. Modifications or changes in occupancy shall not be made from that shown on the lease plan without prior approval.

402.4 Tenant separations: Each tenant space shall be separated from other tenant spaces by a *fire partition* having a fireresistance rating of not less than one hour. The *fire partition* shall comply with 780 CMR 711.0 except that the *fire partition* is not required to extend beyond the underside of a ceiling that is not part of a fireresistance rated assembly. A wall is not required in *attic* or ceiling spaces above tenant separation walls nor is a tenant separation wall required between any tenant space and a mall, except for occupancy separations required elsewhere in 780 CMR.

402.4.1 Anchor store openings: Openings between an anchor store and the pedestrian area of a mall are not required to be protected.

402.4.2 Party wall exemption: Anchor stores located on separate lots shall not be required to provide party walls between the anchor store and the covered mall building.

402.5 Egress: Each individual occupancy within the covered mall building shall be provided with a *means of egress* in accordance with other provisions of 780 CMR. Measurements shall be made to the entrance to the mall.

402.5.1 Travel distance: The maximum length of *exit access* travel from any point within the mall to an approved *exit* along the natural and unobstructed path of travel shall not exceed 200 feet (60960 mm).

402.5.2 Anchor store exits: Anchor stores shall provide the required number of *exits* and the minimum width for the required *exit* capacity directly to the exterior. The occupant load of anchor stores opening into the mall shall not be included in determining *exit* requirements for the mall.

402.5.3 Dead ends: The dead end of a mall shall not exceed twice the width of the mall.

402.5.4 Design occupant load: In determining required *exit* facilities of the mall, the number of occupants for whom *exit* facilities are to be provided shall be based on gross leasable area of the covered mall building (excluding anchor stores) and the occupant load factor as determined by the following formula:

$$OLF = (0.00007)(GLA) + 25$$

where:

OLF = The occupant load factor (square feet per person).
GLA = The gross leasable area (square feet).

The occupant load factor (OLF) is not required to be less than 30 and shall not exceed 50.

402.5.5 Exit access width: The minimum width of *exit access* passageways and *corridors* from a mall shall be 66 inches (1676 mm).

402.5.6 Exit distribution: The required *exits* and *exit* widths shall be distributed equally throughout the mall.

402.5.7 Storage prohibited: Storage is prohibited in *exit corridors* that are used for service to tenants. Such *corridors* shall be posted with conspicuous signs so stating.

402.5.8 Passenger transportation terminals: A covered mall building whose primary purpose is a passenger transportation terminal shall comply with the *means of egress* requirements for Use Group A-3.

402.5.9 Service areas fronting on exit passageways and corridors: Mechanical rooms, electrical rooms, building service areas and service elevators are permitted to open directly into *exit* passageways and *exit corridors* provided that the required fireresistance rating of the *exit* enclosure is maintained.

402.6 Mall width: The minimum width of the mall shall be 20 feet (6096 mm). There shall be a minimum of ten feet (3048 mm) clear *exit* width to a height of eight feet (2438 mm) between any projection of a tenant space bordering the mall and the nearest kiosk, vending machine, bench, display opening or other obstruction to *means of egress* travel. The mall width shall be sufficient to accommodate the occupant load emptying into the immediately adjacent mall as determined by 780 CMR 402.5.4 for all occupancies except Use Groups A and E which shall be determined by 780 CMR 1008.0.

402.7 Structural elements: Covered mall buildings shall be of Type 1,2 or 4 construction. Covered mall buildings three stories or less in *height* are exempt from the *area* limitations of Table 503.

402.7.1 Structural elements, anchor stores: An anchor store three stories or less in *height* shall be of Type 1, 2 or 4 construction and is exempt from the *area* limitations of Table 503, provided that a smoke control system conforming to 780 CMR 921.0 is installed in the anchor store. For the purposes of the design and operation of the fire emergency ventilation system, the anchor store shall be considered a tenant space zone.

402.8 Roof coverings: Roof coverings for covered mall buildings shall be of Class A, B or C as required by 780 CMR 1506.0.

402.9 Use Groups A-1 and A-2: Use Group A-1 and A-2 occupancies shall not have more than one-half of their required *means of egress* opening directly to the mall (see 780 CMR 1006.2.2).

402.10 Sprinkler system: The mall and all buildings connected thereto shall be equipped throughout with an *automatic sprinkler system* in accordance with 780 CMR 906.2.1. The system shall be installed in such a manner that when any portion of the system serving tenant spaces is shut down, the portion of the system serving the mall will remain operational.

402.11 Standpipes: There shall be a *standpipe* hose connection located within the mall at each entrance to an *exit* passageway, *exit corridor* or enclosed stairway and at all exterior entrances to the mall. The hose connection shall be supplied from the *automatic sprinkler system* of the mall or from a separate *standpipe* system. The *water supply* shall be capable of delivering 250 gallons per minute (gpm) (0.016 m^3/s).

402.12 Smoke control: The mall and adjacent tenant spaces shall be equipped with a smoke control system conforming to 780 CMR 921.0.

402.13 Fire department access to equipment controls: *Fire protection system* and HVAC system controls shall be identified, and the fire department shall have access thereto.

402.14 Plastic panels and plastic signs: Within every story or level and from side wall to side wall of each tenant space, approved *plastic* panels and signs shall be limited as specified in 780 CMR 402.14.1 through 402.14.4.

402.14.1 Area: The panels and signs shall not exceed 20% of the wall area facing the mall.

402.14.2 Height and width: The panels and signs shall not exceed a height of 36 inches (914 mm);

except if the panel or sign is vertical, the height shall not exceed 96 inches (2438 mm) and the width shall not exceed 36 inches (914 mm).

402.14.3 Location: The panels and signs shall be located a minimum distance of 18 inches (457 mm) from adjacent tenants.

402.14.4 Encasement: All edges and the backs shall be fully encased in metal.

402.15 Kiosks: Kiosks and similar structures (temporary or permanent) shall meet the requirements of 780 CMR 402.15.1 through 402.15.4.

402.15.1 Construction: Combustible kiosks or other structures shall not be located within the mall unless constructed of fireretardant-treated wood throughout conforming to 780 CMR 2310.0.

402.15.2 Fire suppression: Kiosks and similar structures that are covered and are located within the mall shall be protected by an *automatic sprinkler system* installed in accordance with 780 CMR 9.

402.15.3 Horizontal separation: The minimum horizontal separation between kiosks and other structures within the mall shall be 20 feet (6096 mm).

402.15.4 Maximum area: Kiosks or similar structures shall have a maximum area of 300 square feet (27.90 m^2).

402.16 Parking structures: An attached *garage* for the storage of passenger vehicles that have a capacity of not more than nine persons, or an open parking structure, shall be considered as a separate building where it is separated from the covered mall building by a *fire separation assembly* having a fireresistance rating of not less than two hours or shall be considered as part of the covered mall building.

780 CMR 403.0 HIGH-RISE BUILDINGS

403.1 Applicability: The provisions of 780 CMR 403.0 shall apply to all buildings more than ***70 feet in height above the mean grade. See M.G.L. c. 148, § 26A***.

Exception: The provisions of 780 CMR 403.0 shall not apply to open parking structures (see 780 CMR 406.0 and M.G.L. c. 148, § 26G).

403.2 Sprinkler system: All buildings and structures shall be equipped throughout with an *automatic sprinkler system* in accordance with 780 CMR 906.2.1 and M.G.L. c. 148, § 26A.

Exception: An *automatic sprinkler system* shall not be required in spaces or areas of:

1. Open parking structures complying with 780 CMR 406.0.
2. Telecommunications equipment buildings used exclusively for telecommunications equipment, associated electrical power distribution equipment, batteries and standby engines, provided that those spaces or areas are equipped throughout with an automatic fire detection system in accordance with 780 CMR 918.0 and are separated from the remainder of the building with *fire separation assemblies* consisting of one-hour fireresistance rated walls and two-hour fireresistance rated floor/ceiling assemblies.

403.3 Alternative sprinkler system: Alternatively, to qualify for the fireresistance rating reduction for certain building elements listed in 780 CMR 403.3.3, the *automatic sprinkler system* shall comply with 780 CMR 906.2.1 and the optional fire protection features listed in 780 CMR 403.3.1 and 403.3.2.

403.3.1 Control valves and water-flow devices: *Sprinkler* control valves equipped with supervisory initiating devices and water-flow initiating devices shall be provided for each floor.

403.3.2 Secondary water supply: In addition to the main *water supply*, for buildings located where the effective peak velocity-related acceleration (A_v) is equal to or greater than 0.20 in accordance with 780 CMR 1612.1, a secondary on-site *water supply* equal to the hydraulically calculated *sprinkler* design demand plus 100 gallons per minute (0.0063 m^3/s) shall be provided. This *water supply* shall have a duration of 30 minutes.

403.3.3 Automatic sprinkler system alternative: Where a complete *automatic sprinkler system* with additional system features listed in 780 CMR 403.3.3.1 and 403.3.3.2 is installed throughout, modifications to this code are permitted as described in 780 CMR 403.3.3.1 and 403.3.3.2.

403.3.3.1 Type of construction: Other than in buildings with an occupancy in Use Groups F-l, H-3, M and S-l, the minimum type of construction required by 780 CMR shall be modified as indicated in Table 403.3.3.1.

Exception: The Type 1A to 1B modification shall be permitted for buildings with an occupancy in Use Groups F-1, M and S-1.

Table 403.3.3.1
TYPE OF CONSTRUCTION MODIFICATIONS PERMITTED FOR HIGH-RISE BUILDINGS

Type of Construction set forth in Table 602	Modified type of construction permitted hereunder
1A	1B
1B	2A[a]
2A	2B

Note a. The minimum fireresistance rating floor construction shall be two hours.

403.3.3.2 Shaft enclosures: The required fireresistance rating of the *fire separation assemblies* enclosing vertical *shafts*, other than stairway enclosures and elevator hoistway enclosures, shall be reduced to one hour where automatic *sprinklers* are installed within the *shafts* at the top and at alternate floor levels.

403.4 Automatic fire detection: A smoke detector suitable for the intended application shall be installed in each of the following rooms: mechanical equipment; electrical; transformer; telephone equipment; elevator machine; or similar room. The actuation of any detector shall sound an alarm at a constantly attended location.

403.5 Voice/alarm signaling systems: A voice/alarm signaling system shall be provided in accordance with 780 CMR 917.9 and activated in accordance with 780 CMR 917.7.1.

403.6 Fire department communication system: A two-way fire department communication system shall be provided for fire department use. The communication system shall operate between the *fire command station* and every elevator, elevator lobby and enclosed *exit stairway*. Acceptable types of fire department communications shall include:

1. Telephone or fire department radio in lieu of a dedicated system, where approved by the fire department; and
2. Intercom or two-way public address system complying with NFiPA 72 listed in *Appendix A*.

403.7 Fire command station: A *fire command station* for fire department operations shall be provided in a location approved by the fire department. The *fire command station* shall contain: the voice/alarm signaling system controls; the fire department communication system controls; the automatic fire detection and protective signaling system annunciator panels; an annunciator that visually indicates the floor location of elevators and whether they are operational; status indicators and controls for air-handling systems; controls for unlocking all *stairway* doors simultaneously; *sprinkler* valve and water-flow detector display panels; emergency and standby power; status indicators; and a telephone for fire department use with controlled access to the public telephone system.

403.8 Elevators: Elevator operation and installation shall be in accordance with ***524 CMR***. Elevator service shall be provided for fire department emergency access to all floors. Elevator cab dimensions shall conform to the applicable requirements of 524 CMR.

Except for the main entrance level, all elevators shall open into a lobby separated from the remainder of the building by one hour fireresistance rated construction.

Exit stairways, chutes, janitor closets, tenant spaces in Use Group R and service rooms shall not open into the elevator lobby. In Use Groups other than R, tenant spaces opening into the elevator lobby shall be provided with other means of exit access that do not require passage through the elevator lobby.

> **Exception**: elevator lobbies are not required when a smoke control system is installed in accordance with 780 CMR 921.7.

403.9 Standby power, light and emergency systems: Standby power, light and emergency systems shall comply with the requirements of 780 CMR 403.9.1 through 403.9.3.

403.9.1 Standby power: A standby power system conforming to the requirements of ***527 CMR as listed in Appendix A***. If the standby system is a generator set inside a building, the system shall be located in a separate room enclosed with two-hour fireresistance rated *fire separation assemblies*. System supervision with manual start and transfer features shall be provided at the *fire command station*.

403.9.1.1 Fuel supply: An on-premises fuel supply, sufficient for not less than two-hour full-demand operation of the system, shall be provided.

> **Exception**: Where the system is supplied with pipeline natural gas and is approved.

403.9.1.2 Capacity: The standby system shall have a capacity and rating that supplies all equipment required to be operational at the same time. The generating capacity is not required to be sized to operate all of the connected electrical equipment simultaneously.

403.9.1.3 Connected facilities: All power and lighting facilities for the *fire command station* and elevators specified in 780 CMR 403.7 and 403.8, as applicable, and electrically powered fire pumps required to maintain pressure, shall be transferable to the standby source. Standby power shall be provided for at least one elevator to serve all floors and be transferable to any elevator.

403.9.2 Separate circuits and fixtures: Separate lighting circuits and fixtures shall be required to provide sufficient light with an intensity of not less than one footcandle (10.76 lux) measured at floor level in all *means of egress corridors*, *stairways*, *smokeproof enclosures*, elevator cars and lobbies, and other areas which are clearly a part of the escape route.

403.9.2.1 Other circuits: All circuits supplying lighting for the *fire command station* and mechanical equipment rooms shall be transferable to the standby source.

403.9.3 Emergency systems: *Exit* signs, *exit* illumination as required by 780 CMR 1024.0, and elevator car lighting are classified as emergency systems and shall operate within ten seconds of failure of the normal power supply and shall be capable of being transferred to the standby source.

Exception: *Exit* sign, *exit* and *means of egress* illumination are permitted to be powered by a standby source in buildings of Use Groups F and S.

403.10 Stairway door operation: All *stairway* doors which are to be locked from the *stairway* side shall be capable of being unlocked simultaneously without unlatching upon a signal from the *fire command station.*

403.10.1 Stairway communication system: A telephone or other two-way communication system connected to an approved constantly attended station shall be provided at not less than every fifth floor in each required stairway where the doors to the *stairway* are locked.

403.11 Smokeproof enclosures: A smokeproof enclosure, as set forth in 780 CMR 1015.0 is required for at least one exit. Other required stairways greater than 70 feet in height shall be pressurized to a minimum of 0.15 inches of water column, but not exceeding 0.35 inches of water column. Such required stairway pressurization being relative to building pressure and with all stairway doors closed. Pressurization design shall take into consideration maximum anticipated stack pressure effects in the stairway.

The stairway pressurization system shall be activated by any devices which are required to activate the voice alarm system described in 780 CMR 403.5.

780 CMR 404.0 ATRIUMS

404.1 General: The term "atrium" shall mean an occupied space that includes a floor opening or series of floor openings, which connects two or more stories. An atrium shall comply with 780 CMR 404.0 where a *shaft* enclosure is required by 780 CMR 713.3. Atriums shall be permitted in all occupancies, other than Use Group H, where provided with the protection herein required.

404.2 Automatic sprinkler system: The atrium and all stories and floor areas connected to the atrium shall be equipped throughout with an *automatic sprinkler system* in accordance with 780 CMR 906.2.1. The *automatic sprinkler system* shall be supervised in accordance with 780 CMR 923.1, method 1, 2 or 3.

Exception: An *automatic sprinkler system* shall not be required in areas separated from the atrium by *fire separation assemblies* in accordance with 780 CMR 709.0.

404.3 Atrium occupancy: The floor of the atrium shall not be occupied for other than low fire-hazard occupancies and only approved materials and decorations shall be located in the atrium space.

Exception: The occupancy of the atrium floor area for any approved purpose shall not be restricted where the hazard is protected with an *automatic sprinkler system* installed in accordance with 780 CMR 906.2.1.

404.3.1 Exit discharge: *Exit* discharge in accordance with 780 CMR 1020.0 is permitted within the atrium.

404.4 Smoke control: A smoke control system complying with 780 CMR 921.0 shall be installed in all atriums that connect more than two stories.

404.5 Enclosure of atriums: Atrium spaces shall be separated from adjacent spaces by a one-hour *fire partition* as required for corridors.

Exceptions

1. In residential occupancies, protected openings are not required where the floor area of each guest room or *dwelling unit* does not exceed 1,000 square feet (93 m^2) and each room or unit has an approved *means of egress* not entering the atrium.
2. Adjacent spaces shall be separated from the atrium by *fire windows* or by a tempered, wired, laminated glass or glass-block wall subject to the following criteria:
   2.1. The glass shall be protected by a specially designed *automatic sprinkler system*. The *sprinkler system* shall completely wet the entire surface of the glass wall when actuated. Where there are walking surfaces on both sides of the glass, both sides of the glass shall be so protected;
   2.2. The tempered, wired or laminated glass shall be in a gasketed frame and installed in such a manner that the framing system will deflect without breaking (*loading*) the glass before the *sprinkler system* operates;
   2.3. The glass-block wall assembly shall be installed in accordance with the listing for a ¾-

hour fireresistance rating and the requirements of 780 CMR 2115.0; and
2.4. Obstructions, such as curtain rods, drapery traverse rods, curtains, drapes or similar materials shall not be installed between the automatic *sprinklers* and the glass.
3. The adjacent spaces of any three floors of the atrium shall not be required to be separated from the atrium; however, these spaces shall be included in the atrium volume for the design of the smoke control system (see 780 CMR 921.0).

404.6 Signaling system: A fire protective signaling system shall be installed in all occupancies with an atrium that connects more than two stories. The system shall be activated in accordance with 780 CMR 917.7.1. Such occupancies in Use Group A, E or M shall be provided with a voice/alarm signaling system complying with the requirements of 780 CMR 917.9.

404.7 Travel distance: In other than the lowest level of the atrium, where the required *means of egress* is through the atrium space, the portion of *exit access* travel distance within the atrium space shall not exceed 150 feet (45720 mm).

780 CMR 405.0 UNDERGROUND STRUCTURES

405.1 Applicability: The provisions of 780 CMR 405.0 apply to all structures having a floor level used for human occupancy more than 30 feet (9144 mm) below, or more than one story below, the lowest *level of exit discharge* serving that floor level.

Exception: The provisions of 780 CMR 405.0 shall not apply to the following structures:
1. Occupancies in Use Group R-3 equipped throughout with an *automatic sprinkler system* in accordance with 780 CMR 906.0.
2. *Public garages* equipped throughout with an *automatic sprinkler system* in accordance with 780 CMR 906.0.
3. Fixed guideway transit systems.
4. Occupancies in Use Group A-5.
5. Structures wherein the lowest story is the only story that qualifies the structure as an underground structure and which have an area not exceeding 1,500 square feet (140 m^2) and an occupant load less than ten.

405.2 Construction: The underground portion of the structure shall be of Type 1 construction.

405.3 Automatic sprinkler system: The highest *level of exit discharge* serving the underground portions of the structure and all levels below shall be equipped throughout with an *automatic sprinkler system* in accordance with 780 CMR 906.0.

405.4 Compartmentation: In structures that have a floor level more than 60 feet (18288 mm) below the lowest *level of exit discharge*, the highest *level of exit discharge* serving the underground portions of the structure and all levels below shall each be divided into a minimum of two compartments of approximately equal size by a smoke barrier in accordance with 780 CMR 712.0.

Exception: Two compartments are not required in the lowest story where such story has an area of less than 1,500 square feet (140 m^2) and an occupant load of less than ten.

405.4.1 Smoke barrier penetrations: Penetrations of the smoke barrier shall be limited to plumbing and *automatic sprinkler system* piping and electrical raceways. The air supply, return and exhaust system provided in one compartment shall be independent of such systems provided in other compartments.

405.4.2 Elevators: Where elevators are provided, each compartment shall have direct access to an elevator. Where an elevator serves more than one compartment, an elevator lobby shall be provided and shall be separated from both compartments by a *fire separation assembly* having not less than a one-hour fireresistance rating.

405.4.3 Egress: Each compartment shall contain not less than one *exit* and shall also have an *exit access* doorway into the adjoining compartment.

405.5 Smoke exhaust system: Where compartmentation is required by 780 CMR 405.4, each compartment shall have an independent automatically activated smoke exhaust system capable of manual operation. The system shall have an air supply and smoke exhaust capability which will provide a minimum of six air changes per hour.

405.5.1 Automatic fire detection: A smoke detector complying with 780 CMR 918.8 and suitable for the intended use shall be installed in each of the following rooms: mechanical equipment; electrical; transformer; telephone equipment; elevator machine; or similar room. The actuation of any detector shall sound an alarm at a constantly attended location.

405.5.2 Activation: The smoke exhaust system shall be activated in the compartment of origin by actuation of the following, independently of each other:
1. *Automatic sprinkler system*;
2. Smoke detectors required by 780 CMR 405.5.1; and
3. Manual controls provided for fire department use.

405.6 Fire protective signaling system: Where the lowest level of a structure is more than 60 feet (18288 mm) below the lowest *level of exit* *discharge*, the structure shall be equipped throughout with a fire protective signaling system in accordance with 780 CMR 917.0, including a voice/alarm signaling system installed in accordance with 780 CMR 917.9 and activated in accordance with 780 CMR 917.7.1.

405.7 Public address: Where a fire protective signaling system is not required by 780 CMR 405.6 or 917.4, a public address system shall be provided which shall be capable of transmitting voice communications to the highest *level of exit discharge* serving the underground portions of the structure and all levels below.

405.8 Standby power: A standby power system of sufficient capacity and rating and conforming to the requirements of ***527 CMR 12.00 as listed in Appendix A*** shall be provided.

405.8.1 Fuel supply: If the standby system is a generator set inside a structure, the system shall be located in a separate room enclosed with two-hour fireresistance fire rated *fire separation assemblies*. System supervision with manual start and transfer features shall be provided at the central station.

405.8.2 Capacity: The standby system shall supply the following required systems:

1. Smoke exhaust system.
2. *Smokeproof enclosure*.
3. Fire pumps.
4. One elevator to serve all floors with the capability of transferring power to any elevator.
5. Emergency electrical system.

405.9 Emergency power: An emergency electrical system of sufficient capacity and rating and conforming to the requirements of ***527 CMR 12.00 as listed in Appendix A*** shall be provided. The emergency system shall supply the following required systems:

1. Voice communication system.
2. Fire protective signaling system.
3. Fire detection systems.
4. Elevator car lighting.
5. *Means of egress* lighting and *exit* sign illumination.

780 CMR 406.0 OPEN PARKING STRUCTURES

406.1 General: Open parking structures are those structures used for the parking or storage of passenger motor vehicles designed to carry not more than nine persons, wherein provision for the repair of such vehicles is not made and where the exterior walls of the structure have openings on not less than two sides. Open parking structures are not required to conform to 780 CMR 408.0 for *public garages*.

406.1.1 Openings: The exterior walls of the open parking structure shall have uniformly distributed openings on not less than two sides totaling not less than 40% of the building perimeter. The aggregate area of such openings in exterior walls in each level shall not be less than 20% of the total perimeter wall area of each level. Interior wall lines and column lines shall be at least 20% open with openings distributed to provide *ventilation*.

Exception: Openings are not required to be distributed over 40% of the building perimeter where the required openings are uniformly distributed over two opposing sides of the building.

406.1.2 Separation: Exterior walls containing openings shall have a *fire separation distance* of greater than ten feet (3048 mm).

406.2 Construction requirements: Passenger vehicle structures shall be constructed of approved non combustible materials throughout, including structural framing, floors, roofs and walls. Any enclosed room or space on the premises shall comply with the applicable requirements of 780 CMR.

406.3 Fuel dispensing: Areas where fuel is dispensed shall conform to the requirements of 780 CMR 408.4.

406.4 Heights and areas: *Heights* and *areas* of open parking structures shall not exceed the limitations specified in Table 406.4, except as provided for in 780 CMR 406.4.1. The *heights* and *areas* are subject to the increases indicated in 780 CMR 504.0 and 506.0. The above *height* limitations permit parking on the roof.

Table 406.4
HEIGHT AND AREA LIMITATIONS FOR OPEN PARKING STRUCTURES

Type of construction	Height[a]	Area (square feet)[a]
1A and 1B	Unlimited	Unlimited
2A	12 Stories - 120 feet	Unlimited
2B	10 Stories - 100 feet	50,000
2C	8 Stories - 85 feet	50,000

Note a. 1 foot = 304.8 mm; 1 square foot = 0.093 m^2

406.4.1 Unlimited area: Structures with all sides open shall be unlimited in *area* provided that the *height* does not exceed 75 feet (22860 mm). For a side to be considered open, the total area of openings along the side shall not be less than 50% of the exterior area of the side at each parking level and such openings shall be equally distributed along the length of each level. All portions of each parking level shall be within 200 feet (60960 mm) horizontally from an exterior wall opening on any permanent open space.

406.5 Guards: All open-sided floor areas shall be provided with a guard in accordance with 780 CMR 1021.0, except that in those structures wherein vehicles are hoisted to the desired level and placed in the parking space entirely by approved mechanical means, the guard is not required on the side of the parking levels adjacent to the space occupied by the hoisting and placing equipment.

406.6 Wheel guards: Wheel guards made of approved noncombustible material shall be placed wherever required.

780 CMR 407.0 PRIVATE GARAGES

407.1 General: *Private garages* shall comply with the requirements of 780 CMR 407.0. All *private garages* not falling within the purview of 780 CMR 407.3 through 407.7 and which are attached to or located beneath a building shall comply with the requirements of 780 CMR 313.0 for *public garages*.

407.2 Definitions: The following words and terms shall, for the purposes of 780 CMR 407.0 and as used elsewhere in 780 CMR, have the meanings shown herein.

Garage, private: A garage for four or less passenger motor vehicles, four or less single motor airplanes, or one commercial motor vehicle, without provision for repairing or servicing such vehicles for profit.

407.3 Beneath rooms: *Private garages* located beneath habitable rooms in occupancies in Use Group R-1, R-2, R-3 or I-1 shall be separated from adjacent interior spaces by *fire partitions* and floor/ceiling assemblies which are constructed with not less than a one-hour fireresistance rating. Wood structural members of the minimum dimensions specified in 780 CMR 2304.0 for Type 4 construction shall be acceptable without any further protection where a one-hour fireresistance rating is required.

407.4 Attached to rooms: *Private garages* attached side-by-side to rooms in occupancies in Use Group R-1, R-2, R-3 or I-1 shall be completely separated from the interior spaces and the *attic* area by means of ⅝-inch Type-X gypsum board or the equivalent applied to the garage side.

407.5 Door sills: The sills of all door openings between *private garages* and adjacent interior spaces shall be raised not less than four inches (102 mm) above the garage floor.

407.6 Opening protectives: The door opening protectives shall comply with one of the following.

1. 1¾-inch solid core wood door.
2. 1¾-inch solid or honeycomb core steel door.

407.7 Firestopping of concealed spaces: Where a garage is connected to an occupancy in Use Group R-3 by a concealed space, such as a breezeway, that is of Type 5B construction and ten feet (3048 mm) or greater in length, the junction of the garage and the concealed space shall be *firestopped* to comply with 780 CMR 720.0.

407.8 Means of egress: Where living quarters are located above a *private garage*, the required *means of egress* facilities shall be separated from the garage area with one-hour fireresistance rated construction.

780 CMR 408.0 PUBLIC GARAGES

408.1 General: *Public garages* shall comply with the applicable requirements of 780 CMR 408.0. Those portions of *public garages* where paint spraying is done shall comply with the requirements of 780 CMR 419.0.

408.2 Definitions: The following words and terms shall, for the purposes of 780 CMR 408.0 and as used elsewhere in 780 CMR have the meanings shown herein.

Garage, public: A building or structure for the storage or parking of more than four passenger motor vehicles, motor-powered boats or private or commercial airplanes, or more than one commercial motor vehicle. Public garages shall be classified in one of the following groups according to their specific occupancies:

Group 1: A public garage occupied for the storage, parking, repairing or the painting of, or the dispensing of fuel to, motor vehicles.

Group 2: A public garage occupied exclusively for passenger vehicles that will accommodate not more than nine passengers.

408.3 Construction: All *Group 1 public garages* hereafter erected shall be classified as Use Group S-1 and all *Group 2 public garages* shall be classified as Use Group S-2; both shall conform to the *height* and *area* limitations of Table 503 except as specifically provided for herein.

408.3.1 Sprinkler system: All *public garages* shall be equipped throughout with an *automatic sprinkler system* in accordance with 780 CMR 906.2.1:

1. Where any *fire area* exceeds 12,000 square feet (1116 m^2) ;
2. Where the total area of all *fire areas* on all floors exceeds 24,000 square feet (2232 m^2);
3. Where any *fire area* is more than three *stories above grade*; or
4. Where located beneath other use groups.

For the purposes of 780 CMR 408.0, a roof occupied for the parking or storage of motor vehicles shall not constitute a story.

408.3.2 Roof storage of motor vehicles: Where the roof of a building is occupied for the parking or storage of motor vehicles, such roof shall be provided with a parapet wall or a guard constructed in accordance with 780 CMR 1021.0, and with a wheel guard not less than six inches (152 mm) in height that is located so as to prevent any vehicle from striking the parapet wall or guard.

408.3.3 Floor construction: The *floor finish* of *public garages*, including airplane hangers, shall be of concrete or other approved nonabsorbent, noncombustible material.

408.4 Fuel-dispensing areas: Fuel-dispensing areas shall be located on the level nearest grade. *Public garages* with fuel-dispensing areas shall be completely separated from any other use group by *fire separation assemblies* having a minimum fireresistance rating of two hours. The floors of the fuel-dispensing areas shall be graded to a floor drainage system such that any fuel spill or leak is contained within the area. The drainage system shall conform to the requirements of the plumbing code listed in *Appendix A*. The fuel-dispensing area shall be equipped with an *automatic sprinkler system* in accordance with 780 CMR 9.

408.4.1 Fuel-dispensing systems: All fuel-dispensing and fuel storage systems shall conform to the requirements of the mechanical code listed in *Appendix A*.

408.5 Ventilation: All *public garages* shall be *ventilated* in accordance with the mechanical code listed in *Appendix A*. Fuel-dispensing areas shall be mechanically ventilated.

408.6 Special hazards: Any process conducted in conjunction with *public garages* which involves volatile *flammable* solvents shall be segregated or located in a detached building or structure, except as provided for in 780 CMR 418.0 for the storage and handling of gasoline and other volatile *flammables*. The quantity of *flammable liquids* stored or handled in *public garages* except in underground storage tanks, in special enclosures where permitted in accordance with NFiPA 30A and the fire prevention code listed in *Appendix A*, and in the tanks of motor vehicles— shall not be more than five gallons (0.019 m^2) in approved safety cans.

780 CMR 409.0 USE GROUP I-2

409.1 General: All occupancies in Use Group I-2 shall comply with the provisions of 780 CMR 409.0 and all other applicable provisions of 780 CMR, except that 780 CMR 409.0 shall not apply to occupancies in Use Group I-2 that are not equipped throughout with an *automatic sprinkler system* in accordance with 780 CMR 906.0.

Note: Hospitals, nursing homes and convalescent homes shall be constructed of Type 1 construction, in accordance with M.G.L. c. 111, §§ 51 and 71.

409.2 Corridors: All *corridors* in occupancies in Use Group I-2 shall be continuous to the *exits* and separated from all other areas except waiting areas, nurses' stations and mental health treatment areas conforming to 780 CMR 409.2.1 through 409.2.4.

409.2.1 Waiting areas: Waiting areas shall not be open to the *corridor*, except where all of the following criteria are met:

1. The aggregate area of waiting areas in each *smoke compartment* does not exceed 600 square feet ($56m^2$);
2. Each area is located to permit direct visual supervision by facility staff;
3. Each area is equipped with an automatic fire detection system installed in accordance with 780 CMR 918.0; and
4. Each area is arranged so as not to obstruct access to the required *exits*.

409.2.2 Waiting areas of unlimited area: Spaces constructed as required for *corridors* shall not be open to a *corridor*, except where all of the following criteria are met:

1. The spaces are not occupied for patient sleeping rooms, treatment rooms or specific occupancy areas as defined in 780 CMR 302.1.1;
2. Each space is located to permit direct visual supervision by the facility staff;
3. Both the space and *corridors* that the space opens into in the same *smoke compartment* are protected by an automatic fire detection system installed in accordance with 780 CMR 918.0; and
4. The space is arranged so as not to obstruct access to the required *exits*.

409.2.3 Nurses' stations: Spaces for doctors' and nurses' charting, communications and related clerical areas shall not be open to the *corridor*, except where such spaces are constructed as required for *corridors*.

409.2.4 Mental health treatment areas: Areas wherein only mental health patients who are capable of self-preservation are housed, or group meeting or multipurpose therapeutic spaces other than specific occupancy areas as defined in 780 CMR 302.1.1, under continuous supervision by facility staff, shall not be open to the *corridor*, except where all of the following criteria are met:

1. Each area does not exceed 1,500 square feet (140 m^2);

2. The area is located to permit supervision by the facility staff;
3. The area is arranged so as not to obstruct any access to the required *exits*;
4. The area is equipped with an *automatic fire detection system* installed in accordance with 780 CMR 918.0;
5. Not more than one such space is permitted in any one *smoke compartment*; and
6. The walls and ceilings of the space are constructed as required for *corridors*.

409.3 Corridor walls: *Corridor* walls shall form a barrier to limit the transfer of smoke. The walls shall extend from the floor to the underside of the floor or roof deck above or to the underside of the ceiling above where the ceiling membrane is constructed to limit the transfer of smoke.

409.3.1 Corridor doors: *Corridor* doors, other than those in a wall required to be rated by 780 CMR 302.1.1 or for the enclosure of a vertical opening or an *exit*, shall not have a required fireresistance rating and shall not be required to be equipped with self-closing or automatic-closing devices, but shall provide an effective barrier to limit the transfer of smoke and shall be equipped with positive latching. Roller latches are not permitted. All other doors shall conform to 780 CMR 716.0.

409.3.2 Locking devices: Locking devices which restrict access to the patient room from the *corridor*, and which are operable only by staff from the *corridor* side, shall not restrict the *means of egress* from the patient room except for patient rooms in mental health facilities. Also see 780 CMR 1017.4.1.8(2).

409.4 Smoke barriers: Smoke barriers shall be provided to subdivide every story used by patients for sleeping or treatment into at least two *smoke compartments*. Such stories shall be divided into *smoke compartments* with an area of not more than 22,500 square feet (2092 m^2) and the travel distance from any point in a *smoke compartment* to a smoke barrier door shall not exceed 150 feet (45720 mm). The smoke barrier shall be in accordance with 780 CMR 712.0.

409.4.1 Refuge area: At least 30 net square feet (2.8 m^2) per patient shall be provided within the aggregate area of *corridors*, patient rooms, treatment rooms, lounge or dining areas and other low-hazard areas on each side of each smoke barrier. On floors not housing patients confined to a bed or litter, at least six net square feet (0.56 m^2) per occupant shall be provided on each side of each smoke barrier for the total number of occupants in adjoining *smoke compartments*.

409.4.2 Independent egress: A *means of egress* shall be provided from each *smoke compartment* created by smoke barriers without having to return through the *smoke compartment* from which *means of egress* originated.

409.5 Automatic sprinkler system: *Smoke compartments* containing patient sleeping rooms shall be equipped throughout with an *automatic sprinkler system* in accordance with 780 CMR 906.2.1. Patient sleeping rooms shall be equipped with quick-response *sprinklers*.

409.5.1 Automatic fire detection: Patient sleeping rooms in nursing homes (both intermediate care and skilled nursing facilities) and detoxification facilities shall be provided with a smoke detector that is permanently connected to the normal power supply and that complies with the requirements of UL 217 or UL 268 listed in *Appendix A*. Such detectors shall provide a visual display on the *corridor* side of each patient room and shall provide an audible and visual alarm at the nursing station attending that room. Where such detectors and related devices are not combined with the nursing call system, the detectors shall be installed in accordance with 780 CMR 918.0.

Exceptions:
1. Smoke detectors are not required in patient rooms equipped with automatic door-closing devices with integral smoke detectors on the room sides installed in accordance with their listing, provided that the integral detectors perform the required alerting function.
2. Patient-room smoke detectors installed in accordance with 780 CMR 918.0 are not required to activate the fire protective signaling system where the visual and audible alarms required in 780 CMR 409.5.1 are provided.
3. Sleeping rooms of a child care facility as specified in 780 CMR 308.3.1.

780 CMR 410.0 USE GROUP I-3

410.1 General: All occupancies in Use Group I-3 shall comply with the provisions of 780 CMR 410.0 and all other applicable provisions of 780 CMR (see 780 CMR 308.4).

410.2 Mixed use groups: Portions of buildings with an occupancy in Use Group I-3 which are classified as a different use group shall meet the applicable requirements of 780 CMR for such use groups. Where security operations necessitate the locking of required *means of egress*, provisions shall be made for the release of occupants at all times.

410.3 Means of egress: Except as modified or as provided for in 780 CMR 410.0, the provisions of 780 CMR 10 shall apply.

410.3.1 Door width: Doors to resident sleeping rooms shall have a clear width of not less than 28 inches (711 mm).

410.3.2 Sliding doors: Where doors in a *means of egress* are of the horizontal-sliding type, the force to slide the door to its fully open position shall not exceed 50 pounds (222 N) with a perpendicular force against the door of 50 pounds (222 N).

410.3.3 Horizontal exits: *Horizontal exits* shall be permitted to comprise 100% of the *exits* required provided that access to an *exit*, other than a *horizontal exit*, is available in another fire compartment without requiring return through the compartment of origin. At least six square feet (0.56 m^2) of available space per occupant shall be provided on each side of the *horizontal exit* for the total number of occupants in the compartment served by that *exit*.

410.3.4 Spiral stairs and alternating tread stairways: Spiral stairs that conform to the requirements of 780 CMR 1014.6.4 and *alternating tread stairways* that conform to the requirements of 780 CMR 1014.6.6 are permitted for access to and in between staff locations.

410.3.5 Exit discharge: *Exits* are permitted to discharge into a fenced or walled courtyard. Enclosed yards or *courts* shall be of a size to accommodate all occupants, a minimum of 50 feet (15240 mm) from the building with a net area of 15 square feet (1.4 m^2) per person.

410.3.6 Sallyports: A sallyport shall be permitted in a *means of egress* where there are provisions for continuous and unobstructed passage through the sallyport during an emergency exiting condition. A sallyport is a security vestibule with two or more doors where the intended purpose is to prevent continuous and unobstructed passage by allowing the release of only one door at a time.

410.3.7 Exit stairways: One of the required *exit stairways* in each building shall be permitted to have glazing installed in doors and interior walls at each landing level providing access to the *stairway*, provided that all of the following conditions are met:

1. The *stairway* shall not serve more than four floor levels.
2. Stair doors shall not be less than ¾-hour *fire doors* complying with 780 CMR 716.0.
3. The total area of glazing at each floor level shall not exceed 5,000 square inches (3.23 m^2) and individual panels of glazing shall not exceed 1,296 square inches (0.84 m^2).
4. The glazing shall be protected on both sides by an *automatic sprinkler system*. The *sprinkler* system shall be designed to wet completely the entire surface of any glazing affected by fire when actuated.
5. The glazing shall be in a gasketed frame and installed in such a manner that the framing system will deflect without breaking (loading) the glass before the *sprinkler* system operates.
6. Obstructions, such as curtain rods, drapery traverse rods, curtains, drapes or similar materials shall not be installed between the automatic *sprinklers* and the glazing.

410.4 Locks: *Egress* doors are permitted to be locked in accordance with the applicable use condition. Doors from an area of refuge to exterior are permitted to be locked with a key lock the in lieu of locking methods described in 780 CMR 410.4.1. The keys to unlock the exterior doors shall be available at all times and the locks shall be operable from both sides of the door.

410.4.1 Remote release: All remote release of locks on doors in a *means of egress* shall be provided with reliable means of operation, remote from the resident living areas, to release locks on all required doors. In Occupancy Conditions III or IV, the arrangement, accessibility and security of the release mechanism(s) required for *egress* shall be such that with the minimum available staff at any time, the lock mechanisms are capable of being released within two minutes.

Exception: Provisions for remote locking and unlocking of occupied rooms in Occupancy Condition IV are not required provided that not more than ten locks are necessary to be unlocked in order to move all occupants from one *smoke compartment* to an area of refuge within three minutes. The opening of all necessary locks shall be accomplished with not more than two separate keys.

410.4.2 Power-operated doors and locks: All power-operated sliding doors or power-operated locks for swinging doors shall be operable by a manual release mechanism at the door, and either emergency power or a remote mechanical operating release shall be provided.

410.4.3 Redundant operation: Remote release, mechanically operated sliding doors or remote release, mechanically operated locks shall be provided with a mechanically operated release mechanism at each door, or shall be provided with a redundant remote release control.

410.4.4 Relock capability: Doors remotely unlocked under emergency conditions shall not automatically relock when closed unless specific action is taken at the remote location to enable doors to relock.

410.4.5 Emergency power: Emergency power in accordance with ***527 CMR 12.00 as listed in Appendix A*** shall be provided for all electrically power-operated sliding doors and power-operated locks.

Exception: Facilities with ten locks or less complying with the exception to 780 CMR 410.4.1.

410.5 Vertical openings: Vertical openings shall be enclosed in accordance with 780 CMR 713.3.

Exception: A floor opening between floor levels of residential housing areas is permitted without enclosure protection between the levels, provided that all of the following conditions are met:

1. The entire normally occupied areas so interconnected are open and unobstructed so as to enable observation of the areas by supervisory personnel.
2. *Means of egress* capacity is sufficient to provide simultaneous egress for all occupants from all interconnected levels and areas.
3. The height difference between the highest and lowest finished floor levels shall not exceed 23 feet (7010 mm). Each story, considered separately, has at least one-half of its individual required *means of egress* capacity provided by *exits* leading directly out of that story without traversing another story within the inter-connected area.

410.6 Smoke barrier: All occupancies in Use Group I-3 shall have smoke barriers complying with 780 CMR 712.0 to divide every story occupied by residents for sleeping, or any other story having an occupant load of 50 or more persons, into at least two *smoke compartments*.

Exception: Spaces having direct *exit* to one of the following, provided that the locking arrangement of the doors involved complies with the requirements for doors at the compartment barrier for the use condition involved:

1. A *public way*;
2. A building separated from the resident housing area by a two-hour fireresistance rated assembly or 50 feet (15240 mm) of open space; or
3. A secured yard or *court* having a holding space 50 feet (15240 mm) from the housing area that provides six square feet (0.56 m^2) or more of refuge area per occupant including residents, staff and visitors.

410.6.1 Smoke compartments: The maximum number of residents in any *smoke compartment* shall be 200. The travel distance to a door in a smoke barrier from any room door required as *exit access* shall not exceed 150 feet (45720 mm). The travel distance to a door in a smoke barrier from any point in a room shall not exceed 200 feet (60960 mm).

410.6.2 Refuge area: At least six net square feet per occupant shall be provided on each side of each smoke barrier for the total number of occupants in adjoining *smoke compartments*. This space shall be readily available whenever the occupants are moved across the smoke barrier in a fire emergency.

410.6.3 Independent egress: A *means of egress* shall be provided from each *smoke compartment* created by smoke barriers without having to return through the *smoke compartment* from which *means of egress* originates.

410.7 Subdivision of resident housing areas: Sleeping areas including an individual cell or *dormitory* and any contiguous day room, group activity space or other common spaces where residents are housed shall be separated from all other spaces in accordance with 780 CMR 410.7.1 through 410.7.4.

410.7.1 Occupancy Conditions III and IV: Each sleeping area in Occupancy Conditions III and IV shall be separated from the adjacent common spaces by a smoke-tight partition where the travel distance from the *dormitory* room or cell through the common space to the *exit access corridor* exceeds 50 feet (15240 mm).

410.7.2 Occupancy Condition V: Each sleeping area in Occupancy Condition V shall be separated from adjacent sleeping areas, *corridors* and common spaces by a smoke-tight partition. Additionally, common spaces shall be separated from the *exit access corridor* by a smoke-tight partition.

410.7.3 Openings in room face: The aggregate area of all openings in a solid sleeping room face in Occupancy Conditions II, III, IV and V shall not exceed 120 square inches (77419 mm^2). The aggregate area shall include all openings including door undercuts, food passes and grilles. All openings shall be not more than 36 inches (914 mm) above the floor. In Occupancy Condition V, the openings shall be closable from the room side.

410.7.4 Smoke-tight doors: Doors in openings in partitions required to be smoke tight by 780 CMR 410.7 shall be substantial doors, of construction that will resist the passage of smoke. Latches and door closers are not required on cell doors.

410.8 Windowless buildings: For the purposes of 780 CMR 410.8, a windowless building or portion of a building is one with nonopenable windows, windows not readily breakable or without windows. Windowless buildings shall be provided with vent openings, smoke *shafts* or an engineered smoke control system to provide *ventilation* (mechanical or natural) for each windowless *smoke compartment*.

780 CMR 411.0 MOTION PICTURE PROJECTION ROOMS, SCREENING ROOMS AND SOUND STAGES

(Refer to M.G.L. c. 143, § 89 for additional information regarding cellulose nitrate film and Appendix A for related Code of Massachusetts Regulations [CMR's]).

411.1 General: The provisions of 780 CMR 411.0 shall apply to rooms in which ribbon-type cellulose acetate or other safety film is utilized in conjunction with electric arc, xenon or other light-source projection equipment which develops hazardous gases, dust or radiation. Where cellulose nitrate film is utilized or stored, such rooms shall comply with NFiPA 40 listed in ***Appendix A***.

Every motion picture machine projecting film as mentioned within the scope of 780 CMR 411.0 shall be enclosed in a projection room. Appurtenant electrical equipment, such as rheostats, transformers and generators, shall be within the projection room or in an adjacent room of equivalent construction. There shall be posted on the outside of each projection room door and within the projection room itself, a conspicuous sign with one-inch (25 mm) block letters stating "Safety Film Only Permitted in this Room".

411.2 Construction of projection rooms: Every projection room shall be of permanent construction consistent with the construction requirements for the type of building in which the projection room is located. Openings are not required to be protected.

The room shall have a floor area of not less than 80 square feet (7.44 m^2) for a single machine. Each motion picture projector, floodlight, spotlight or similar piece of equipment shall have a clear working space of not less than 30 inches by 30 inches (762 mm by 762 mm) on each side and at the rear thereof, but only one such space shall be required between two adjacent projectors. The projection room and the rooms appurtenant thereto shall have a ceiling height of not less than seven feet six inches (2286 mm). The aggregate of openings for projection equipment shall not exceed 25% of the area of the wall between the projection room and the auditorium. All openings shall be provided with glass or other approved material, so as to close completely the opening.

411.3 Projection booth and equipment ventilation: Projection booths and equipment shall be *ventilated* in accordance with the mechanical code listed in ***Appendix A***.

411.4 Lighting control: Provision shall be made for control of the auditorium lighting and the *means of egress* lighting systems of theaters from inside of the room and from at least one other convenient point in the building as required in 780 CMR 1024.3.1.

411.5 Miscellaneous equipment: Each projection room shall be provided with rewind and film storage facilities.

411.6 Screening rooms: Screening rooms shall provide a seating capacity of not more than 30 persons, with not less than two approved *means of egress* complying with 780 CMR 10. Such rooms shall be enclosed in one-hour *fire separation assemblies*. All seats shall be permanently fixed in position and the arrangement shall comply with the requirements of 780 CMR 1012.0.

411.7 Sound stage construction: All sound stages for motion picture or television productions shall be equipped throughout with an *automatic sprinkler system* installed in accordance with 780 CMR 9.

780 CMR 412.0 STAGES AND PLATFORMS

412.1 Applicability: The provisions of 780 CMR 412.0 shall apply to all parts of buildings and structures which contain *stages* or *platforms* and similar appurtenances as herein defined.

412.2 Definitions: The following words and terms shall, for the purposes of 780 CMR 412.0 and as used elsewhere in 780 CMR, have the meanings shown herein.

Platform: A platform is a raised area within a building for: the presentation of music, plays or other entertainment; the head table for special guests; the raised area for lectures and speakers; boxing and wrestling rings; theater-in-the-round; and similar purposes wherein there are no overhead hanging curtains, drops, scenery or *stage* effects other than lighting. A temporary platform is one installed for not more than 30 days.

Stage: A stage is a partially enclosed portion of a building which is designed or used for the presentation of plays, demonstrations or other entertainment. A stage shall be further classified as either a legitimate stage, regular stage or thrust stage.

Stage, legitimate: A *stage* wherein curtains, drops, leg drops, scenery, lighting devices or other stage effects are retractable horizontally or suspended overhead.

Stage, regular: A *stage* wherein curtains, fixed leg drops, valances, scenery and other stage effects are hung and are not retractable.

Stage, thrust: A *platform* extending beyond the proscenium arch and into the audience.

412.3 Stages: *Stage* construction shall comply with 780 CMR 412.3.1 through 412.3.9.

412.3.1 Stage floor construction: Openings through all *stage* floors shall be equipped with tight-fitting, solid wood trap doors not less than two inches in nominal thickness with approved safety locks or other materials of equal physical and fire endurance properties.

412.3.1.1 Legitimate stages: Legitimate *stages* shall be constructed of materials as required for floors for the type of construction, but not less than Type 1B construction except that the portion of the legitimate *stage* extending back from and six feet (1829 mm) beyond the full width of the proscenium opening on each side shall be permitted to be constructed of noncombustible or heavy timber construction covered with a wood floor of not less than two inches nominal in thickness. Except for the finished floor, combustible construction shall not extend beyond the plane of the proscenium opening.

412.3.1.2 Regular and thrust stages: Regular *stages* and thrust *stages* shall be constructed of materials as required for floors for the type of construction of the building in which such *stages* are located.

412.3.2 Stage rigging loft: The rigging loft, also referred to as the loft or fly, is the space over the *stage* where scenery and equipment is out of view. The fly gallery is the narrow raised platform at the side of the legitimate *stage* from which the lines for flying scenery are manipulated. The gridiron is the arrangement of beams over a legitimate *stage* supporting the machinery for flying scenery and hanging battens from which lighting is hung. The pin rail is the beam at one side of a legitimate *stage* through which wooden or metal pins are driven and to which lines from the flies are fastened. The rigging loft, fly galleries, gridiron and pin rails shall be constructed of approved noncombustible materials.

412.3.3 Footlights and stage electrical equipment: Footlights and border lights shall be installed in troughs constructed of approved noncombustible materials. Ready access shall be provided at all times to the switchboard. The storage or placing of *stage* equipment against the switchboard shall be prohibited.

412.3.4 Exterior stage doors: Where protection of openings is required, *exit discharge* door openings to the outer air shall be protected with *fire doors* that comply with 780 CMR 716.0. All exterior openings which are located on the *stage* for *means of egress* or loading and unloading purposes, and which are likely to be open during occupancy of the theater, shall be constructed with vestibules to prevent air drafts into the auditorium.

412.3.5 Proscenium wall: Legitimate *stages* shall be completely separated from the seating area by a proscenium wall with not less than a two-hour fireresistance rating extending continuously from the foundation to the roof. There shall not be other openings in the wall separating a legitimate *stage* from the auditorium except: the main proscenium opening; two doorways at the *stage* level, one on each side thereof; and one doorway to the musician's pit from the space below the *stage* floor. Each such doorway shall not exceed 45 square feet (4.19 m^2) in area and shall be protected with *fire doors* that comply with 780 CMR 716.0.

412.3.5.1 Trim, finish and decorative hangings: All moldings and decorations around the proscenium opening shall be constructed entirely of approved noncombustible material.

412.3.6 Proscenium curtain: The proscenium opening of every legitimate *stage* shall be provided with a curtain of approved material designed and installed to intercept hot gases, flames and smoke, and to prevent a glow from a severe fire on the *stage* from showing on the auditorium side for a period of 30 minutes. The closing of the curtain from the full open position shall be effected in less than 30 seconds, but the last eight feet of travel shall require not less than five seconds.

412.3.6.1 Activation: The curtain shall be activated by rate-of-rise heat detection operating at a rate of temperature rise of 15 to 20°F per minute (8° to 11°C per minute); and by an auxiliary manual control.

412.3.6.2 Fire test: A sample curtain with a minimum of two vertical seams shall be subjected to the standard fire test specified in ASTM E119 listed in ***Appendix A*** for a period of 30 minutes. The curtain shall overlap the furnace edges by an amount that is appropriate to seal the top and sides. The curtain shall have a bottom pocket containing a minimum of four lbs. per linear foot (6 kg/m) of batten. The exposed surface of the curtain shall not glow, and flame or smoke shall not penetrate the curtain during the test period. Unexposed surface temperature and hose stream test requirements are not applicable to the proscenium fire safety curtain test.

412.3.6.3 Smoke test: Curtain fabrics shall have a smoke-developed rating of 25 or less when tested in accordance with ASTM E84 listed in ***Appendix A***.

412.3.6.4 Tests: The completed proscenium curtain shall be subjected to operating tests prior to the issuance of a certificate of occupancy.

412.3.7 Scenery: All combustible materials used in sets and scenery shall be rendered flame-resistant to comply with 780 CMR 8.

412.3.8 Stage ventilation: Emergency *ventilation* shall be provided for *stages* larger than 1,000 square feet (93 m^2) in floor area, or with a *stage* height greater than 50 feet (15240 mm). Such *ventilation* shall comply with 780 CMR 412.3.8.1 or 412.3.8.2

412.3.8.1 Roof vents: Two or more vents constructed to open automatically by approved heat-activated devices and with and aggregate clear opening area of not less than 5% of the area of the *stage* shall be located near the center and above the highest part of the *stage* area, except as otherwise provided for in 780 CMR 412.3.9. Supplemental means shall be provided for manual operation of the ventilator. Curbs shall be provided as required for skylights in 780 CMR 2608.2.

412.3.8.2 Smoke control: Smoke control in accordance with 780 CMR 921.0 shall be provided to maintain the smoke layer interface not less than six feet (1829 mm) above the highest level of the assembly seating or above the top of the proscenium opening where a proscenium wall is required by 780 CMR 412.3.5.

412.3.9 Superimposed theaters: Additions or extensions shall not be erected over the *stage* section of a theater, nor shall a second theater be erected above another. Where approved, the prohibition against superimposed theaters and construction above the *stage* shall not apply where approved access is provided for fire fighting with direct means of *ventilation* to the outer air from the *stage* portion.

412.4 Platforms: *Platform* construction shall comply with 780 CMR 412.4.1 and 412.4.2.

412.4.1 Materials: In buildings required to be of Type 1 or Type 2 construction where the *platforms* are not more than 30 inches (762 mm) above the main floor level, the minimum type of construction for a permanent *platform* shall be Type 2C. For all types of construction where the *platforms* are not more than 30 inches (762 mm) above the main floor level, not larger in area than 10% of the room floor area and not more than 200 square feet (19 m2) in area, the minimum type of construction for a permanent *platform* shall be Type 5B. For all types of construction where the *platforms* are not more than 30 inches (762 mm) above the main floor level, not larger than ⅓ of the room floor area and not more than 3,000 square feet (279 m^2) in area, the minimum type of construction for a permanent *platform* shall be Type 4 or the *platform* shall be constructed of fireretardant-treated wood. All other permanent *platforms* shall be constructed of approved materials as required for floors for the required type of construction of the building in which it is located. Temporary *platforms* shall be constructed of any approved material.

412.4.2 Space beneath: The space between the floor and a temporary *platform* above shall not be utilized for any purpose other than electrical wiring to *platform* equipment. Where the space between the floor and a permanent *platform* above is utilized for any purpose other than electrical wiring or plumbing, the *platform* shall provide a one-hour fireresistance rating.

412.5 Dressing and appurtenant rooms: Dressing and appurtenant rooms shall comply with 780 CMR 412.5.1 through 412.5.3.

412.5.1 Construction: Dressing rooms, scene docks, property rooms, workshops, storerooms and all compartments appurtenant to the *stage* shall be separated from each other and from the stage and all other parts of the building by *fire separation assemblies* with not less than a one-hour fireresistance rating with approved opening protectives. Such rooms shall not be placed immediately over or under the operating *stage* area.

Exception: Separation from the *stage* is not required for *stages* having a floor area of 500 square feet (46.5 m^2) or less.

412.5.2 Opening protectives: Openings other than to trunk rooms and the necessary doorways at *stage* level shall not connect such rooms with the *stage*, and such openings shall be protected with *fire doors* that comply with 780 CMR 716.0.

412.5.3 Dressing room and stage exits: Each tier of dressing rooms shall be provided with at least two *means of egress*. *Means of egress* stairways from dressing and storage rooms are not required to be enclosed where located in the *stage* area behind the proscenium wall. At least one approved *means of egress* shall be provided from each side of the *stage*; from each side of the space under the *stage*; from each fly gallery; and from the gridiron. A steel ladder shall be provided from the gridiron to a scuttle in the *stage* roof.

412.6 Automatic sprinkler system: *Stages* and enclosed *platforms* shall be equipped with an *automatic sprinkler system* in accordance with 780 CMR 412.0 and 780 CMR 906.0 or 780 CMR 907.0. The system shall be installed: under the roof and gridiron, in the tie and fly galleries and in all places behind the proscenium wall of the *stage*; over and within enclosed platforms in excess of 500 square feet (46.5 m^2) in area; and in dressing rooms, lounges, workshops and storerooms accessory to such *stages* or enclosed *platforms*.

Exceptions:
1. *Stages* or enclosed *platforms* open to the auditorium room on three or more sides.
2. Altars, pulpits or similar *platforms* and accessory rooms.
3. *Stage* gridirons where sidewall *sprinklers* with 135°F (57°C) rated heads with heat-baffle plates are installed around the perimeter of the *stage* except for the proscenium opening at points not more than 30 inches (762 mm) below the gridiron nor more than six inches (152 mm) below the baffle plate.
4. Under *stage* or enclosed *platform* areas less than four feet (1219 mm) in clear height utilized

for storage, the *stage* and supporting structures shall be of one-hour fireresistance rated construction.

412.7 Standpipes: A wet *standpipe system* in accordance with 780 CMR 914.0 shall be provided and equipped with 1½-inch hose connections on each side of the *stage*.

> **Exception**: Where the building or area is equipped throughout with an *automatic sprinkler system*, the hose connections that are supplied from the *automatic sprinkler system* shall have a *water supply* of not less than that required by NFiPA 13 listed in ***Appendix A***.

> **412.7.1 Hose and cabinet**: The hose connections shall be equipped with sufficient lengths of 1½ - inch hose to provide fire protection for the *stage* area; such connections shall be equipped with an approved adjustable fog nozzle and be mounted in a cabinet or a rack.

780 CMR 413.0 SPECIAL AMUSEMENT BUILDINGS

413.1 General: Special amusement buildings shall comply with the requirements for buildings of the appropriate assembly use group in addition to the requirements of 780 CMR 413.0.

> **Exception**: Buildings or portions thereof that are essentially open to the outside air, such as buildings without walls or without a roof and arranged to prevent the accumulation of smoke in the building or structure are not required to comply with 780 CMR 413.0.

413.2 Special amusement building: A special amusement building is any temporary, permanent or mobile building or portion thereof which is occupied for amusement, entertainment or educational purposes and which contains a device or system which conveys passengers or provides a walkway along, around or over a course in any direction so arranged that the *means of egress* path is not readily apparent due to visual or audio distractions or is intentionally confounded or is not readily available due to the nature of the attraction or mode of conveyance through the building or structure.

413.3 Fire detection: All special amusement buildings shall be equipped with an automatic fire detection system in accordance with 780 CMR 918.0.

> **Exception**: In areas where the ambient conditions will cause a smoke detector to activate, an approved alternative type of automatic detector shall be installed.

413.4 Automatic sprinklers: All special amusement buildings shall be equipped throughout with an *automatic sprinkler system* in accordance with 780 CMR 906.0. Where the special amusement building is temporary or mobile, the *sprinkler water supply* shall be of an approved temporary means.

> **Exception**: An *automatic sprinkler system* is not required where the total floor area of a temporary special amusement building is less than 1,000 square feet (93 m^2) and the travel distance from any point to an *exit* is less than 50 feet (15240 mm).

413.5 System response: The activation of the automatic fire detection system within a single protected area or the *automatic sprinkler system* shall automatically:

1. Cause illumination of the *means of egress* with light of not less than one footcandle (10.76 lux) at the walking surface level;
2. Stop any conflicting or confusing sounds and visual distractions; and
3. Activate an approved directional *exit* marking that will become apparent in an emergency.

> **413.5.1 Alarm**: Activation of any single smoke detector, the *automatic sprinkler system* or any other automatic fire detection device shall immediately sound an alarm at the building at a constantly attended location from which emergency action can be initiated including the capability of manual initiation of requirements in 780 CMR 413.5.

> **413.5.2 Public address system**: A public address system, which is also permitted to serve as an alarm system, shall be provided and shall be audible throughout the entire special amusement building.

> **413.5.3 Exit marking**: "Exit" signs shall be installed at required *exit* doorways. Approved directional exit markings shall also be provided and shall include signs as required by 780 CMR 1023.0. Where mirrors, mazes or other designs are used that confound the *means of egress* paths, approved low-level "exit" signs and directional path markings shall be provided and located not more than eight inches (203 mm) above the walking surface and on or near the *means of egress* path. Such markings shall become visible when activated in accordance with 780 CMR 413.5, item 3.

413.6 Interior finish: The interior finish shall be Class I in accordance with 780 CMR 803.2.

413.7 Required inspections. Buildings or portions thereof, classified as *special amusement buildings* shall be inspected on an annual basis to ensure compliance with the applicable portions of 780 CMR.

780 CMR 414.0 AIRPORT TRAFFIC CONTROL TOWERS

414.1 General: The provisions of 780 CMR 414.0 shall apply to airport traffic control towers not exceeding 1,500 square feet per floor occupied only for air traffic control, electrical and mechanical equipment rooms, radar and electronics rooms, office spaces incidental to tower operation and lounges for employees, including restrooms.

414.2 Type of construction: Air traffic control towers shall be constructed to conform to the *height* and *area* limitations of Table 414.2.

Table 414.2
HEIGHT AND AREA LIMITATIONS FOR AIRPORT TRAFFIC CONTROL TOWERS

Type of construction	Height[a,b]	Maximum area (square feet)[b]
1A, 1B	Unlimited	1,500
2A	240 feet	1,500
2B	100 feet	1,500
2C	85 feet	1,500

Note a. Height to be measured from grade to cab floor.

Note b. 1 foot - 304.8 mm; 1 square food = 0.093m^2.

414.3 Egress: A minimum of one exit *stairway* shall be permitted for airport traffic control towers of any *height* provided that the occupant load per floor does not exceed 15. The *stairway* shall conform to the requirements of 780 CMR 1014.0 and 1015.0. The *stairway* shall be separated from elevators by a minimum distance of ½ of the diagonal of the area served.

> **Exception**: *Smokeproof enclosures* as set forth in 780 CMR 1015.0 are not required where required *stairways* are pressurized to a minimum of 0.15 inch of water column (37.33 P) and a maximum of 0.35 inch of water column (87.10 P) in the *shaft* relative to the building with all *stairway* doors closed.

414.4 Automatic fire detection systems: Airport traffic control towers shall be provided with an automatic fire detection system installed in accordance with 780 CMR 918.0.

414.5 Standby power: A standby power system that conforms to 780 CMR 403.9 and ***527 CMR 12.00 as listed in Appendix A*** shall be provided in airport traffic control towers more than 65 feet (19812 mm) in *height*. Power shall be provided to mechanical equipment servicing *smokeproof enclosures* and stairway pressurization systems, *means of egress* lighting, elevator operational equipment and the automatic fire detection system.

780 CMR 415.0 OUTDOOR PROCESSING FACILITIES

415.1 Industry standards: Outdoor processing facilities such as chemical plants, refineries and grain elevators shall be constructed in accordance with the accepted engineering practice of the specific industry and the fire prevention code listed in ***Appendix A***, subject to the approval of the ***the building code enforcement official and the fire prevention officer***.

780 CMR 416.0 HPM FACILITIES

416.1 Scope: The provisions of 780 CMR 416.0 shall apply to buildings and structures using *hazardous production materials* (*HPM*), such as in semiconductor fabrication facilities and areas of comparable research and development. Except as specifically required by 780 CMR 416.0, such buildings shall comply with the applicable requirements of 780 CMR. The specific code provisions of 780 CMR 307.0, 506.3 and Table 1009.2 applicable to high-hazard use groups shall not apply unless stated herein.

416.2 Definitions: The following words and terms shall, for the purposes of 780 CMR 416.0 and as used elsewhere in 780 CMR, have the meanings shown herein.

Emergency control station: An approved location on the premises where signals from emergency equipment are received and which is staffed by trained personnel.

Fabrication area: A fabrication area is one in which there are processes involving *hazardous production materials* (*HPM*), and includes ancillary rooms or areas, such as dressing rooms and offices, which are supplemental to the area processes.

Hazardous production material (HPM): A solid, liquid or gas that has a degree of hazard rating in health, flammability or reactivity of Class 3 or 4 as ranked by NFiPA 704 listed in ***Appendix A*** and which is used directly in research, laboratory or production processes which have as their end product, materials which are not hazardous.

Service passage, HPM: A passage in which *hazardous production materials* (*HPM*) are transported from a *separate inside HPM storage room* or the exterior of the building to the perimeter wall of the *fabrication area*, for purposes other than required *means of egress*.

Storage room, HPM, separate inside: A room in which *hazardous production materials* (*HPM*) are stored in containers, tanks, drums or other means, and which is separated from other occupancies. Such rooms include:

HPM cutoff room: An *HPM* storage room within a building and having at least one exterior wall.

HPM inside room: An *HPM* storage room totally enclosed within a building and not having exterior walls.

416.3 Allowable heights, stories and area: The allowable *height*, number of stories and basic *areas* permitted for HPM buildings and structures shall not exceed the limitations specified in Table 416.3. The provisions of 780 CMR 507.0 shall not apply. The area limitations are for one- or two-story buildings facing on a street or public space not less than 30 feet (9144 mm) wide. The increases permitted in 780 CMR 506.2 and 506.3 shall apply.

Table 416.3
HEIGHT, NUMBER OF STORIES AND AREA LIMITATIONS FOR HPM USE FACILITIES

Type of construction	Number of stories	Height (feet)[a]	Area (square feet/floor)[a]
1A and 1B	3	55	Unlimited
2A	3	55	34,200
2B	3	55	22,500
2C	3	40	14,400
3A	3	50	19,800
3B	3	40	14,400
4	3	55	21,600
5A	3	40	15,300
5B	2	30	7,200

Note a. 1 foot = 304.8 mm; 1 square foot = 0.093 m^2

416.4 Fire suppression: *HPM* facilities shall be equipped throughout with an *automatic sprinkler system* in accordance with 780 CMR 9. The design for the *fabrication areas*, *service passages*, *separate inside HPM storage rooms* without dispensing, and *means of egress corridors* shall meet the requirements for Ordinary Hazard Group 2 in NFiPA 13 listed in ***Appendix A***. The design for *separate inside HPM storage rooms* with dispensing shall meet the requirements for Extra Hazard Group 2 in NFiPA 13 listed in ***Appendix A***.

416.5 Amount of HPM in a fabrication area: The total amount of *HPM* permitted in a single *fabrication area* shall be based on the densities in Table 416.5(2), or the quantities in Table 416.5(1), whichever is the larger amount.

Table 416.5(1)
PERMITTED AMOUNTS OF HPM IN A SINGLE FABRICATION AREA-QUANTITY BASIS

Material	Maximum quantity[a]
Flammable liquids	
Class I-A	90 gallons
Class I-B	180 gallons
Class I-C	270 gallons
Combination flammable liquids containing not more than the exempt amounts of Class I-A, I-B or I-C flammable liquids	360 gallons
Combustible liquids	
Class II	360 gallons
Class III-A	750 gallons
Flammable gases	9,000 cubic feet at one atmosphere of pressure at 70°F
Liquefied flammable gases	180 gallons
Flammable solids	1,500 pounds
Corrosive liquids	165 gallons
Oxidizing material - gases	18,000 cubic feet
Oxidizing material - liquids	150 gallons
Oxidizing material - solids	1,500 pounds
Organic peroxides	30 pounds
Highly toxic material and poisonous gas	Included in the aggregate for flammables as noted above

Note a. 1 gallon - 0.00379 m^3; 1 cubic foot = 0.028 m^3; 1 pound = 0.454 kg; degrees C = {(degrees F)-32}/1.8.

Table 416.5(2)
PERMITTED AMOUNTS OF HPM IN A SINGLE FABRICATION AREA—DENSITY BASIS [a, c]

State	Units[d]	Flam-mable	Oxi-dizer	Cor-rosive
Solid	Pounds per aquare foot	0.001	0.003	0.003
Liquid	Gallons per square foot	0.04[b]	0.03	0.08
Gas	Cubic feet per square foot	1.250	1.250	3.000

Note a. HPM within piping shall not be included in the calculated quantities.

Note b. The maximum permitted quantities of flammable and combustible liquids shall not exceed the following quantities:

Class (I-A) + (I-B) + (I - C) (combination flammable liquids) = .025
However Class I-A shall not exceed = .0025
Class II = .01
Class III-A = .02

Note c. Highly toxic materials and poisonous gases shall be limited by the maximum quantities specified in Table 416.5(1).

Note d. One pound per square foot = 4.882 kg/m^2; 1 gallon per square foot = 0.0407 m^3/m^2; 1 cubic foot per square foot = 0.301 m^3/m^2.

416.6 Egress: There shall not be less than two *means of egress* provided for any *fabrication area* or any *HPM* facility subdivision thereof larger than 200 square feet (18.62 m^2). The maximum length of *exit access* travel in *HPM* facilities shall be 100 feet (30480 mm).

416.7 Separation: *Fabrication areas* shall be separated from each other, from *means of egress corridors*, and from other parts of the building by not less than one-hour *fire separation assemblies* in compliance with 780 CMR 709.0, with *fire doors* complying with 780 CMR 716.0. Floors forming part of the required separation shall be liquid tight.

416.8 Floors: Floors within *fabrication areas* shall be of approved noncombustible construction. Unprotected openings through floors of *fabrication areas* are permitted where the interconnected levels are used solely for mechanical equipment directly related to such *fabrication areas*.

Mechanical, duct and piping penetrations within a *fabrication area* shall not extend through more than two floors. Penetrations shall be effectively *firestopped* in accordance with 780 CMR 720.6.4 at the floor level. The *fabrication area*, including the areas through which ductwork and piping extend, shall be considered a single conditioned space or *fire area*.

416.9 Ventilation, general: *Ventilation* systems shall comply with the mechanical code listed in ***Appendix A*** except as otherwise provided herein. *Ventilation*, including recalculated air, shall be provided throughout the *fabrication area* at the rate of not less than 1cfm per square foot (5074 $cm^3/s/m^2$) of floor area.

416.9.1 Interconnection: The exhaust system of one *fabrication area* shall not connect to another exhaust system outside that *fabrication area* within the building. The return air system from one *fabrication area* shall not connect to any other system.

416.9.2 Smoke detectors: Smoke detectors shall be installed in the recirculating air stream and shall initiate a signal at the *emergency control station*.

416.9.3 Shutoff switches: Automatic shutoffs are not required to be installed on air-moving equipment. A manually operated remote switch to shut off the *fabrication area* supply or the recirculation air system, or both, shall be provided at an approved location outside the *fabrication area*.

416.9.4 Gas detection: Where *HPM* gas is used or dispensed and the physiological warning properties for the gas are at a higher level than the accepted permissible exposure limitation for the gas, a continuous gas-monitoring system shall be provided to detect the presence of a short-term hazard condition. Where dispensing occurs and *flammable* gases or vapors are liberated in quantities exceeding 20% of the lower explosive limitation, a continuous gas-monitoring system shall be provided. The monitoring system shall be connected to the *emergency control station*.

416.10 Transporting HPM: *HPM* shall be transported to *fabrication areas* through enclosed piping or tubing systems which comply with 780 CMR 416.15, through *service passages*, or in *means of egress corridors* as permitted in the exception to 780 CMR 416.12.

416.11 Electrical: Electrical equipment and devices within the *fabrication area* shall comply with 527 CMR listed in ***Appendix A***. The requirements for hazardous locations are not required to be applied where the average rate of air change is at least four cfm per square foot (20300 $cm^3/s/m^2$) of floor area and where the rate of air change at any location is not less than three cfm per square foot (15200 $cm^3/s/m^2$).

416.12 Means of egress corridors: *Means of egress corridors* shall comply with 780 CMR 1011.4 and shall be separated from *fabrication areas* as specified in 780 CMR 416.7. *Means of egress corridors* shall not be used for transporting *HPM* except as provided for in 780 CMR 416.12.1 and 416.15.2.

416.12.1 Existing facilities: In existing *HPM* facilities, when there are alterations or modifications to existing *fabrication areas*, the transportation of *HPM* in *means of egress corridors* shall be permitted provided that all of the requirements of 780 CMR 416.12.1.1 and 416.12.1.2 are met.

416.12.1.1 Corridors: *Corridors* adjacent to the *fabrication area* under *alteration* shall comply with Table 602, item 4, for a length determined as follows:

1. The length of the common wall of the *corridor* and that *fabrication area*; and
2. For the distance along the *corridor* to the point of entry of *HPM* into the *corridor* serving that *fabrication area*.

416.12.1.2 Openings: There shall not be openings between the *corridor* and an *HPM* storage cabinet in a *fabrication area* other than those in compliance with all of the following:

1. one-hour *fire doors* are installed between the *corridor* and the cabinet;
2. The cabinet is separated from the *corridor* with a one-hour fireresistance rated *fire partition*; and
3. Automatic sprinklers shall be provided inside the cabinets

416.13 Service passages: *Service passages* shall be considered as *HPM* facilities. *Service passages* shall be separated from *means of egress corridors* as required by 780 CMR 416.7.

416.13.1 Ventilation: *Service passages* shall be *ventilated* as required by 780 CMR 416.9.

416.13.2 Egress: There shall not be less than two *means of egress* from a *service passage*. Not more than one-half of the required *means of egress* shall be into the *fabrication area*. Doors from *service passages* shall be self-closing and swing in the direction of *means of egress* travel.

416.13.3 Travel distance: The maximum distance of travel from any point in a *service passage* to an *exit* or door into a *fabrication area* shall not exceed 75 feet (22860 mm). Dead ends shall not exceed four feet (1219 mm) in length.

416.13.4 Alarms: Alarms shall be provided for in accordance with 780 CMR 416.14.5.

416.14 Storage of HPM, general: Rooms used for the storage of *HPM* in quantities greater than those set forth in Tables 307.8(1) and 307.8(2), except for those quantities permitted within a *fabrication area*, shall comply with the provisions of NFiPA 30 listed in ***Appendix A***, provided that the area of an HPM *cutoff room* shall not exceed 6,000 square feet (558 m^2). The storage area for any liquid *HPM* shall be provided with drains.

416.14.1 Location within building: Where *HPM cutoff rooms* are provided, such rooms shall not be less than 30 feet (9144 mm) from *lot lines*.

416.14.2 HPM drainage systems: Drainage systems shall be provided to direct liquid leakage and fire protection water to a safe location away from the building, important valves or adjoining property. *HPM flammable liquid* drains shall be separated from other *HPM* liquid drains Other *HPM* liquids in drains that are not compatible shall be separated from each other, provided that the liquids are permitted to be combined when such liquids have been rendered acceptable for discharge by an approved means into the public sewers.

416.14.3 Egress: There shall be two *means of egress* from a *separate inside HPM storage room* where the room exceeds 200 square feet (186 m^2) in area. Where two *means of egress* are required from *HPM cutoff rooms*, one shall be directly to the outside of the building. All storage room *means of egress* doors shall be self-closing and swing in the direction of *means of egress* travel

416.14.4 Ventilation: Exhaust *ventilation* shall be provided for in accordance with 780 CMR 416.9 for all categories of *HPM*.

416.14.5 Emergency alarm: An emergency telephone system or local fire protective signaling system station shall be installed outside of each interior egress door from *HPM cutoff rooms*. The signal shall be relayed to the *emergency control station* and a local signaling device provided.

416.14.6 Electrical: *HPM cutoff rooms* containing *flammable liquids* or gases shall be classified as Class I, Division 1, hazardous locations in accordance with 527 CMR listed in ***Appendix A***.

416.14.7 Gas detection: Gas detection shall be provided for in accordance with 780 CMR 416.9.4.

416.15 Piping and tubing: *HPM* piping and tubing shall comply with 780 CMR 416.15 and shall be installed in accordance with ASME B31.3 listed in ***Appendix A***.

416.15.1 General: Piping and tubing systems shall be metallic unless the material being transported is incompatible with such system. Systems supplying gaseous *HPM*, having a *health hazard* of 3 or 4 as ranked by NFiPA 704 listed in ***Appendix A***, shall be welded throughout, except for connections, valves and fittings which are within an exhausted enclosure. *HPM* supply piping or tubing in *service passages* shall be exposed to view.

416.15.2 Installation in egress corridors or above other use groups: *HPM* shall not be located within *means of egress corridors* or above areas not containing *HPM* facilities except as permitted by 780 CMR 416.15. *HPM* piping and tubing shall be permitted within the space defined by the *walls* of *means of egress corridors* and the floor or roof above, or in concealed spaces above other use groups under the following conditions:

1. Automatic *sprinklers* shall be installed within the space unless the space is less than six inches (152 mm) in least dimension.
2. *Ventilation* at not less than six air changes per hour shall be provided. The space shall not be used to convey air from any other area.
3. All *HPM* supply piping and tubing and HPM non-metallic waste lines shall be separated from the *means of egress corridor* and from any use group other than an *HPM* use facility by a *fire separation assembly* having a fireresistance rating of not less than one hour. Where gypsum wallboard is used, joints on the piping side of the enclosure are not required to be taped, provided that the joints occur over framing members.
4. Where piping or tubing is used to transport *HPM* liquids, a receptor shall be installed below such piping or tubing. The receptor shall be designed to collect and drain any discharge or leakage to an approved location. The one-hour enclosure required by 780 CMR

416.15.2, item 3 shall not be used as part of the receptor.

5. Manual or automatic remotely activated fail-safe emergency shutoff valves, with ready access thereto, shall be installed on piping and tubing, other than waste lines, at branch connections into the *fabrication area*, and at entries into *means of egress corridors*.

6. Where *HPM* supply gas is carried in pressurized piping, a fail-safe system for excess flow control shall shut off flow due to a rupture in the piping.

7 Electrical wiring and equipment located in the piping space shall be approved for Class I, Division 2, hazardous locations in accordance with 527 CMR listed in *Appendix A*.

8. Gas detection shall be as provided for in 780 CMR 416.9.4

> **Exception**: Conditions 1 through 8 shall not apply to transverse crossings of the *corridors* by supply piping that is coaxially enclosed within a ferrous pipe or tube for the width of the *corridor*. An enclosing pipe or tube open to an *HPM* use facility is permitted.

416.15.3 Identification: Piping, tubing and *HPM* waste lines shall be identified in accordance with ASME A13.1 listed in *Appendix A*.

780 CMR 417.0 HAZARDOUS MATERIALS

(See also 780 CMR 426.0 for the design and constriction of Bulk Merchandising Retail Buildings.)

417.1 General: The provisions of 780 CMR 417.0 shall apply to all buildings and structures occupied for the manufacturing, processing, dispensing, use or storage of *hazardous materials*. All buildings and structures with an occupancy in Use Group H shall also comply with the applicable provisions of 780 CMR 418.0 and the fire prevention code listed in *Appendix A*.

> **Note**: The safe design of *hazardous material* occupancies is material dependent. Individual material requirements are also found in 780 CMR 307.0 and 418.0, and in the mechanical and fire prevention codes listed in *Appendix A*. Since the fire department is responsible for inspection of these occupancies for proper utilization and handling of *hazardous materials*, the administrative authority shall cooperate with the fire department in the discharge of the responsibility to enforce 780 CMR 417.0

417.2 Control areas/exempt amounts: *Control areas* shall be those spaces within a building where quantities of *hazardous materials* not exceeding the allowable exempt amounts are stored, dispensed, utilized or handled. *Control areas* shall be separated from all adjacent interior spaces by *fire separation assemblies* in accordance with 780 CMR 709.0. The number of permitted *control areas* and degree of fire separation shall be in accordance with Table 417.2. The floor construction and supporting structure for all floors within the *control area* shall require a minimum two-hour fireresistance rating.

Table 417.2
PERMITTED CONTROL AREAS[a, b]

Floor level	Percent of allowable exempt quantities per control area	Control areas per floor	Vertical fire separation walls (hours)
1	100	4	1
2	75	3	1
3	50	2	1
4	12.5	2	2
5	12.5	2	2
6	12.5	2	2
7-9	5	2	2
Higher than 9	5	1	2

Note a. The number of floor levels below grade shall not exceed two. The first floor level before grade shall be limited to 75% of the maximum allowable exempt quantity per control area with a maximum of three control areas. The second floor level below grade shall be limited to 50% of the maximum allowable exempt quantity per control area with a maximum of two control areas.

Note b. In mercantile occupancies, a maximum of two control areas per floor shall be permitted in retail sales rooms.

417.2.1 Hazardous material in mercantile display areas: ***Except as modified by 780 CMR 426***, the aggregate quantity of nonflammable solid and nonflammable or noncombustible liquid *hazardous materials* permitted within a single *control area* of a retail sales occupancy is permitted to exceed the exempt amounts specified in Tables 307.8(1) and 307.8(2) without classifying the building as a high-hazard use group, provided that the materials are stored in accordance with the fire prevention code listed in *Appendix A*.

417.3 Equipment rooms: Heating and ventilating equipment in occupancies involving fire hazards from *flammable* vapors, dusts, *combustible fibers* or other highly combustible substances shall be installed and protected against fire and explosion hazards in accordance with the mechanical code and the fire prevention code listed in *Appendix A*.

417.4 Hazardous material systems: Systems involving *hazardous materials* shall be suitable for the intended application and shall be designed by persons competent in such design. Controls shall be designed to prevent materials from entering or leaving process or reaction systems at other than the intended time, rate or path. Automatic controls, where provided, shall be designed to be fail safe.

417.5 Inside storage, dispensing and utilization: The inside storage, dispensing and utilization of *hazardous materials* in excess of the allowable exempt amounts of Tables 307.8(1) and 307.8(2) shall be in accordance with 780 CMR 417.5.1 through 417.5.5 and the fire prevention code listed in *Appendix A*.

417.5.1 Explosion control: Every structure, room or space occupied for purposes involving explosion hazards shall be provided with explosion venting, explosion suppression systems, *barricades* or equivalent explosion protective devices in accordance with 780 CMR 417.0 and NFiPA 495 listed in *Appendix A* where required by 780 CMR 418.0 and the fire prevention code listed in *Appendix A*.

Exception: Explosion venting shall not be utilized as a means to protect buildings from *detonation* hazards.

417.5.1.1 Explosion venting: Areas which are provided with explosion venting to relieve *deflagration* shall comply with the following:

1. Walls, ceilings and roofs exposing surrounding areas shall be designed to resist a minimum internal pressure of 100 pounds per square foot (psf).
2. Explosion venting shall be permitted only in exterior walls or roofs or through specially designed *shafts* to the exterior of the building.
3. Venting shall be designed to prevent serious structural damage and the production of lethal projectiles.
4. The aggregate clear vent relief area shall be governed by the pressure resistance of the nonrelieving portions of the building.
5. Vents shall be designed to relieve at a maximum internal pressure of 20 pounds per square foot (psf) and shall consist of any one or any combination of the following:
   - 5.1. Walls of lightweight material.
   - 5.2. Lightly fastened hatch covers.
   - 5.3. Lightly fastened, outward-opening swinging doors in exterior walls.
   - 5.4. Lightly fastened walls or roofs.
6. Venting devices shall discharge directly to the open air or to an unoccupied space not less than 50 feet in width on the same *lot*.
7. Relieving devices shall be so located that the discharge shall not be less than ten feet vertically and 20 feet horizontally from window openings or *exits* in the same or adjoining buildings or structures.
8. Discharge shall be in the direction of least exposure and not into the interior of the building.

417.5.1.2 Explosion suppression systems: Explosion suppression systems shall be of an approved type and installed in accordance with the provisions of 780 CMR and NFiPA 69 listed in *Appendix A*.

417.5.2 Monitor control equipment: Monitor control equipment shall be provided where required by the fire prevention code listed in *Appendix A*.

417.5.3 Detection systems: All occupancies in Use Group H shall be provided with an automatic fire detection system in accordance with NFiPA 72 listed in *Appendix A* where required by the fire prevention code listed in *Appendix A*. The detection system shall be provided in the areas where the high-hazard materials are utilized and stored.

417.5.4 Standby power: Where mechanical *ventilation*, treatment systems, temperature control, alarm, detection or other electrically operated systems are required, such systems shall be connected to an emergency electrical system in accordance with ***527 CMR 12.00 as listed in Appendix A*** or a standby power system in accordance with ***527 CMR 12.00 as listed in Appendix A***. Such systems shall be independent of the public supply.

417.5.5 Spill control, drainage and containment: Rooms, buildings or areas occupied for the storage of solid and liquid *hazardous materials* shall be provided with a means to control spillage and to contain or drain off spillage and fire protection water discharged in the storage area where required in 780 CMR 418.0 and the fire prevention code listed in *Appendix A*.

417.6 Outside storage, dispensing and utilization: The outside storage, dispensing and utilization of *hazardous materials* in excess of the exempt amounts shall be in accordance with 780 CMR 417.6.1 through 417.6.6 and the fire prevention code listed in *Appendix A*.

417.6.1 Location: In addition to the general requirements of 780 CMR 417.6.2 through 417.6.5, the outside storage of *hazardous materials* as listed in 780 CMR 307.0 shall be separated from buildings and *lot lines* and into individual areas as specified in the fire prevention code listed in *Appendix A*.

417.6.2 Protection from vehicles: Guard posts or other means shall be provided to protect outside storage tanks from vehicular damage.

417.6.3 Fire lanes and water supply: Fire lanes and approved water supplies shall be provided for outside storage areas as required by the code official.

1. Fire lanes. Fire lanes shall be provided to within 150 feet (45720 mm) of all portions of an outside storage area. Such fire lanes shall

comply with the provisions of the fire prevention code listed in *Appendix A*.

2. *Water supply*. An approved *water supply* shall be provided. Fire hydrants capable of supplying the required fire flow shall be provided to within 150 feet (45720 mm) of an outside storage area. The *water supply* and fire hydrants shall comply with the provisions of NFiPA 24 and the fire prevention code listed in *Appendix A*.

417.6.4 Weather protection: Where weather protection is provided for sheltering outside *hazardous material* storage areas, such storage shall not be considered inside storage provided that all of the following conditions are met:

1. Structure supports and walls shall not obstruct more than one side of the perimeter of the storage area.
2. The distance from the structure and the structure supports to buildings, *lot lines*, *public ways* or *means of egress* to a *public way* shall not be less than the distance required for an outside *hazardous material* storage area without weather protection.
3. The overhead structure shall be of approved noncombustible construction with a maximum area of 1,500 square feet (140 m^2).

417.6.5 Security: Any site occupied for the storage, utilization or handling of *hazardous materials* shall be provided with a fence not less than six feet (1829 mm) in height or otherwise secured from public access.

417.6.6 Fire suppression system: Areas occupied for the dispensing or utilization of *flammable hazardous materials* which are located within 50 feet of either a storage area or building, and vehicle-loading racks where *flammable hazardous materials* are dispensed, shall be equipped with an approved *automatic fire suppression system*.

Exception: Motor vehicle service stations as defined in NFiPA 30A listed in *Appendix A*.

780 CMR 418.0 USE GROUPS H-1, H-2, H-3 AND H-4

418.1 Scope: The provisions of 780 CMR 418.0 shall apply to the storage and utilization of *hazardous materials* in excess of the exempt amounts listed in 780 CMR 307.8. All buildings and structures with an occupancy in Use Group H shall also comply with the applicable provisions of 780 CMR 417.0 and the fire prevention code listed in *Appendix A*.

418.2 Use Group H-1: All occupancies in Use Group H-1 shall be constructed in accordance with the provisions of 780 CMR 418.2.1 and 418.2.2 and the fire prevention code listed in *Appendix A*.

418.2.1 Construction: Occupancies in Use Group H-1 shall not be located in buildings that are more than one story in *height*, have *basements* or other spaces below grade, or which are attached to other buildings. The minimum *fire separation distance* for all exterior walls of occupancies in Use Group H-1 shall be in accordance with the fire prevention code listed in *Appendix A*. All floor surfaces shall be spark resistant.

418.2.2 Number of exits: There shall not be less than two *exits* from any area or space wherein Use Group H-1 materials are utilized or stored. All required *exits* shall discharge directly to the exterior of the building or structure.

418.3 Use Group H-2: Occupancies in Use Group H-2 shall be constructed in accordance with 780 CMR 418.3.1 through 418.3.4 and the fire prevention code listed in *Appendix A*.

418.3.1 Combustible dusts, grain processing and storage: The provisions of 780 CMR 418.3.1.1 through 418.3.1.6 shall apply to all buildings in which materials that produce *combustible dusts* are stored or handled. Buildings which store or handle *combustible dusts* shall comply with the applicable provisions of NFiPA 61A, 61B, 61C, 61D, 65, 120, 651, 654, 655, 664 and 8503 and the fire prevention code listed in *Appendix A*.

418.3.1.1 Type of construction and height exceptions: All buildings shall be of Type 1, Type 2 or Type 4 construction, within the height and area limitations of Table 503 for Use Group H-2; except that where erected of Type 1 or Type 2 construction, the heights and areas of grain elevators and similar structures shall be unlimited, and where of Type 4 construction, the maximum height shall be 65 feet (19812 mm) and except further that, in isolated areas, the maximum height of Type 4 structures shall be increased to 85 feet (25908 mm).

418.3.1.2 Grinding rooms: Every room or space occupied for grinding or other operations that produce *combustible dusts* shall be enclosed with floors and walls that have not less than a two-hour fireresistance rating where the area is not more than 3,000 square feet (279 m^2), and not less than a four hour fireresistance rating where the area is greater than 3.000 square feet (279 m^2).

418.3.1.3 Conveyors: All *conveyors*, chutes, piping and similar equipment passing through the enclosures of rooms or spaces shall be constructed dirt tight and vapor tight, and be of approved noncombustible materials complying with 780 CMR 3010.0.

418.3.1.4 Explosion relief: Means for explosion relief shall be provided as specified in 780 CMR 417.5.1, or spaces shall be equipped with the equivalent mechanical *ventilation* complying with the mechanical code listed in ***Appendix A***.

418.3.1.5 Grain elevators: Grain elevators, malt houses and buildings for similar occupancies shall not be located within 30 feet (9144 mm) of *interior lot lines* or structures on the same *lot*, except where erected along a railroad right-of-way.

418.3.1.6 Coal pockets: Coal pockets located less than 30 feet (9144 mm) from *interior lot lines* or from structures on the same *lot* shall be constructed of not less than Type 2A construction. Where more than 30 feet (9144 mm) from *interior lot lines*, or where erected along a railroad right-of-way, the minimum type of construction of such structures not more than 65 feet (19812 mm) in height shall be Type 4.

418.3.2 Flammable and combustible liquids: The storage, handling processing and transporting of *flammable* and *combustible liquids* shall be in accordance with the mechanical code and the fire prevention code listed in ***Appendix A***. Where a Class I, II or IIIA *flammable* or *combustible liquid* is stored in tanks inside the building, the installation shall conform to 780 CMR 418.3.2.1 through 418.3.2.10 and NFiPA 30 listed in ***Appendix A***. The requirements shall only apply where tanks have an individual storage capacity that exceeds the exempt amounts specified in Tables 307.8(1) and 307.8(2). The *fire area* containing the tank(s) shall be classified as Use Group H-2.

418.3.2.1 Mixed use groups: Where the storage tank area is located in a building of two or more use groups, the Use Group H-2 *fire area* shall be completely separated from adjacent *fire areas* in accordance with the requirements of 780 CMR 313.1.2.

418.3.2.1.1 Height exception: Where storage tanks are located within only a single story, the *height* limitation of 780 CMR 503.3 shall not apply for the Use Group H-2 *fire area*.

418.3.2.2 Tank protection: All storage tanks shall be noncombustible and protected from physical damage. A *fire separation assembly* around the storage tank(s) shall be permitted to be classified as the method of protection from physical damage.

418.3.2.3 Tanks for Class I flammable liquid: All storage tanks for Class I *flammable liquids* shall be double-wall tanks. A double-wall tank shall consist of an approved tank conforming to the requirements of the mechanical code listed in ***Appendix A***, installed within a completely enclosed noncombustible containment structure. The containment structure shall prevent the stored liquid from escaping into the room or area in which the tank is located. A leak detection alarm shall be provided to identify a leak of the primary wall of the tank. The alarm shall conform to 780 CMR 418.3.2.6.

418.3.2.4 Suppression: The Use Group H-2 *fire area* shall be equipped throughout with an approved *automatic fire sprinkler system*, installed in accordance with 780 CMR 906.2.1, or with a foam-extinguishing system. The *automatic fire suppression system* shall be supervised by method 1, 2 or 3 of 780 CMR 923.1.

418.3.2.5 Leakage containment: A liquid-tight containment area compatible with the stored liquid shall be provided to retain 110% of the entire capacity of all the storage liquid in the event of a leak in a tank plus the capacity of the *automatic fire suppression system* activated for a period of 30 minutes. The storage tanks and the leakage containment area shall be provided with an approved method to drain manually the *flammable* or *combustible liquid*.

Exception: Rooms where only double-wall storage tanks conforming to 780 CMR 418.3.2.3 are used to store Class I, II and IIIA. A *flammable* and *combustible liquids* shall not be required to have a leakage containment area.

418.3.2.6 Leakage alarm: An approved automatic alarm shall be provided to indicate a leak in a storage tank and room. The alarm shall sound an audible signal, 15 dBa above the ambient sound level, at every point of entry into the room in which the leaking storage tank is located. An approved sign shall be posted on every entry door to the tank storage room indicating the potential hazard of the interior room environment, or the sign shall state, "Warning, when alarm sounds, the environment within the room may be hazardous." The leakage alarm shall also be supervised in accordance with 780 CMR 923.2 to transmit a trouble signal.

418.3.2.7 Tank vent: Storage tank vents shall terminate to the outdoor air. The vent termination shall be in an approved location a minimum of 12 feet (3658 mm) above adjacent ground level and ten feet (3048 mm) from a *lot line*, *ventilation* intake opening, openable window or door.

418.3.2.8 Room ventilation: Storage tank areas storing Class I liquids, or Class II or IIIA liquids at temperatures above *flash point*, shall be *ventilated* at a rate sufficient to maintain the concentration of vapors within the area at or below 25% of the lower explosive limit.

Ventilation requirements shall be determined by either calculations based on anticipated fugitive emissions or by sampling of the actual vapor concentration levels under normal operating conditions. The sampling shall be conducted at a five-foot radius from each potential vapor source in the storage area. Provision shall be made for make-up air to avoid short-circuiting the *ventilation*.

418.3.2.9 Explosion venting: Where Class I liquids are being stored, explosion venting shall be provided in accordance with 780 CMR 417.5

418.3.2.10 Tank openings other than vents: Tank openings other than vents from tanks inside buildings shall bedesigned to ensure that liquids or vapor concentrations are not released inside the building and shall conform to 780 CMR 418.3.2.10.1 through 418.3.2.10.5.

418.3.2.10.1 Liquid tight: All tank openings at the maximum liquid level or below shall be liquid tight.

418.3.2.10.2 Closed: All tank openings above the maximum liquid level shall be normally closed.

418.3.2.10.3 External valve: Each connection through which liquid is capable of gravity flow from a tank inside a building shall be provided with an external valve located as close as practical to, but not more than two feet from, the shell of the tank.

418.3.2.10.4 Valves on transfer connections: Tanks storing Class I or Class II liquids shall be provided with either a normally closed, remotely activated valve or an automatic-closing, heat-activated valve or other approved device on each liquid transfer connection below the liquid level, except for connections utilized for emergency disposal.

418.3.2.10.5 Overflow protection: Tanks shall be equipped with a device, or other means provided, to prevent overflow into the building.

418.3.3 Liquefied petroleum gas distribution facilities: The design and construction of propane, butane, propylene, butylene and other liquefied petroleum gas distribution facilities shall conform to the applicable provisions of 780 CMR 418.3.3.1 through 418.3.3.5.2. The storage and handling of liquefied petroleum gas systems shall conform to the fire prevention code listed in ***Appendix A***. The design and installation of piping, equipment and systems which utilize liquefied petroleum gas shall be in accordance with the mechanical code listed in ***Appendix A***. Liquefied petroleum gas distribution facilities shall be *ventilated* in accordance with the mechanical code listed in ***Appendix A*** and 780 CMR 418.3.3.1.

418.3.3.1 Air movement: Liquefied petroleum gas distribution facilities shall be provided with air inlets and outlets arranged so that air movement across the floor of the facility will be uniform. The total area of both inlet and outlet openings shall be at least one square inch (0.00065 m^2) for each one square foot (0.093 m^2) of floor area. The bottom of such openings shall not be more than six inches (152 mm) above the floor.

418.3.3.2 Construction: Liquefied petroleum gas distribution facilities shall be constructed in accordance with 780 CMR 418.3.3.3 for separate buildings, 780 CMR 418.3.3.4 for attached buildings or 780 CMR 418.3.3.5 for rooms within buildings.

418.3.3.3 Separate buildings: Where located in separate buildings, liquefied petroleum gas distribution facilities shall be occupied exclusively for that purpose or for other purposes having similar hazards. Such buildings shall be limited to one story in height and shall conform to 780 CMR 418.3.3.3.1 and 418.3.3.3.2.

418.3.3.3.1 Floors: The floor shall not be located below ground level and any spaces beneath the floor shall be solidly filled or shall be left unenclosed.

418.3.3.3.2 Materials: Walls, floors, ceilings, columns and roofs shall be constructed of noncombustible materials. Exterior walls, ceilings and roofs shall be constructed of material designed for explosion venting or, if of heavy construction such as solid brick masonry, concrete block or reinforced concrete, explosion-venting windows or panels in walls or roofs shall be provided having an explosion-venting area of at least one square foot (0.093 m) for each 50 cubic feet (1.40 m) of enclosed volume.

418.3.3.4 Attached buildings: Where liquefied petroleum gas distribution facilities are located in an attached structure, the attached perimeter shall not exceed 50% of the perimeter of the space enclosed and the facility shall comply with 780 CMR 418.3.3.3 and 418.3.3.4.1. Where the attached perimeter exceeds 50%, such facilities shall comply with 780 CMR 418.3.3.5.

418.3.3.4.1 Fire separation assemblies: Separation of the attached structures shall be provided by *fire separation assemblies* having a fireresistance rating of not less than one hour and shall not have openings. *Fire separation assemblies* between attached structures occupied only for the storage of LP-gas are permitted to have *fire doors* that comply with 780 CMR 716.0. Such *fire separation assemblies* shall be designed to withstand a static pressure of at least 100 pounds per square foot (psf) (488.2 kg/m^2), except where the building to which the structure is attached is occupied by operations or processes having a similar hazard.

418.3.3.5 Rooms within buildings: Where liquefied petroleum gas distribution facilities are located in rooms within buildings, such rooms shall be located in the first story and shall have at least one exterior wall with sufficient exposed area to permit explosion venting as provided for in 780 CMR 418.3.3.5.1. The building in which the room is located shall not have a *basement* or unventilated crawl space and the room shall comply with 780 CMR 418.3.3.5.1 and 418.3.3.5.2.

418.3.3.5.1 Materials: Walls, floors, ceilings and roofs of such rooms shall be constructed of approved noncombustible materials. Exterior walls and ceilings shall be either of lightweight materials designed for explosion venting or, if of heavy construction such as solid brick masonry, concrete block or reinforced concrete, explosion-venting windows or panels in walls or roofs shall be provided having an explosion-venting area of at least one square foot (0.093 m^2) for each 50 cubic feet (1.40 m^3) of enclosed volume.

418.3.3.5.2 Common construction: Walls and floor/ceiling assemblies common to the room and to the building within which the room is located shall have a fireresistance rating of not less than one hour and without openings. Common walls for rooms occupied only for storage of LP-gas are permitted to have openings which shall be equipped with ¾-hour approved opening protectives complying with 780 CMR 716.0 or 718.0. Such walls and ceiling shall be designed to withstand a static pressure of at least 100 psf (488.2 kg/m). Where approved, 780 CMR 418.3.3.5.2 shall not apply where the building, within which the room is located, is occupied by operations or processes having a similar hazard.

418.3.4 Dry cleaning plants: The construction and installation of dry cleaning plants shall be in accordance with the requirements of 780 CMR, the mechanical code, the plumbing code and NFiPA 32 listed in ***Appendix A***.

418.4 Use Group H-3: Occupancies in Use Group H-3 shall be constructed in accordance with the applicable provisions of 780 CMR and the fire prevention code listed in ***Appendix A***.

418.5 Use Group H-4: Occupancies in Use Group H-4 shall be constructed in accordance with the applicable provisions of 780 CMR and the fire prevention code listed in ***Appendix A***.

780 CMR 419.0 APPLICATION OF FLAMMABLE FINISHES

419.1 General: The provisions of 780 CMR 419.0 shall apply to the construction, installation and use of buildings and structures, or parts thereof, for the spraying of *flammable* paints, varnishes and lacquers or other *flammable* materials or mixtures or compounds used for painting, varnishing, staining or similar purposes. All such construction and equipment shall comply with NFiPA 33 and 34 listed in ***Appendix A***.

419.2 Spray spaces: All spray spaces shall be *ventilated* with an exhaust system to prevent the accumulation of *flammable* mist or vapors in accordance with the mechanical code listed in ***Appendix A***. Where such spaces are not separately enclosed, noncombustible spray curtains shall be provided to restrict the spread of *flammable* vapors.

419.2.1 Spray booths: All spray booths shall be constructed of approved noncombustible materials and equipped with mechanical ventilating systems in accordance with the mechanical code listed in ***Appendix A***.

419.2.2 Spray rooms: All spray rooms shall be enclosed in *fire separation assemblies* with not less than a one-hour fireresistance rating. Floors shall be waterproofed and drained in an approved manner.

419.2.3 Spray storage rooms: Rooms used for the storage of spraying materials essential to the *flammable* finish operation shall comply with NFiPA 30 and the fire prevention code listed in ***Appendix A***.

419.3 Fire protection: An *automatic fire suppression system* shall be provided in all spray, dip and immersing spaces and storage rooms, and shall be installed in accordance with 780 CMR 9.

780 CMR 420.0 MOBILE UNITS

420.1 For regulations pertaining to Mobile Units, see 780 CMR 35, ***and 780 CMR R3***.

780 CMR 421.0 SWIMMING POOLS

(Refer to M.G.L. c. 140, § 206 for further requirements pertaining to public or semi-public, outdoor, inground swimming pool enclosures, safety equipment, inspection, and penalties for violations.)

421.1 General: Swimming and bathing pools shall conform to the requirements of 780 CMR 421.0 provided that 780 CMR 421.0 shall not be applicable to any such pool less than 24 inches (610 mm) deep or having a surface area less than 250 square feet (23.25 m^2), except where such pools are permanently equipped with a water-recirculating system or involve structural materials. For the purposes of 780 CMR, pools are classified as private swimming pools, public swimming pools ***or semi-public swimming pools***, as defined in 780 CMR 421.2. Materials and constructions used in swimming pools shall comply with the applicable requirements of 780 CMR.

421.2 Definitions: The following words and terms shall, for the purposes of 780 CMR 421.0 and as used elsewhere in 780 CMR, have the meanings shown herein.

Pools, swimming, hot tubs and spas

Above-ground/on-ground pool: See definition of private swimming pool.

Barrier: A fence, a wall, a building wall or a combination thereof which completely surrounds the swimming pool and obstructs access to the swimming pool. ***(Refer to M.G.L. c. 140, § 206 for required enclosure of public or semi-public, outdoor, inground swimming pools.)***

Hot tub (special purpose pool): A unit designed for recreational and therapeutic use which is shallow in depth and not meant for swimming or diving. These pools are not drained, cleaned or refilled for each user. It may include, but not be limited to hydrojet circulation, hot water, cold water mineral baths, air induction bubbles, or any combination thereof. Industry terminology for such a pool includes but is not limited to, therapeutic pool, hydrotherapy pool, whirlpool, hot spa, hot tubs, float tanks, etc. This standard excludes residential units and facilities used or under the direct supervision and control of licensed medical personnel.

In-ground pool: See definition of private swimming pool.

Private swimming pool: Any structure that contains water over 24 inches (610 mm) in depth and which is used, or intended to be used, for swimming or recreational bathing in connection with an occupancy in Use Group R-3 ***or R-4*** and which is available only to the family and guests of the householder. This includes in-ground, above-ground and on-ground swimming pools, hot tubs and spas.

Private swimming pool, indoor: Any private swimming pool that is totally contained within a private structure and surrounded on all four sides by walls of said structure.

Private swimming pool, outdoor: Any private swimming pool that is not an indoor pool.

Public *outdoor, inground* swimming pool: Any swimming pool ***which is used, or intended to be used, for swimming or recreational bathing by the general public. Refer to M.G.L. c. 140, § 206 for requirements pertaining to public or semi-public, outdoor, inground swimming pool enclosures, safety equipment, inspection, and penalties for violations.***

Public swimming pool, outdoor: Any public swimming pool that is not defined as an outdoor, inground swimming pool.

Semi-public outdoor, inground swimming pool: (as defined by M.G.L. c. 140, § 206) any swimming or wading pool on the premises of, or used in connection with, a hotel, motel, trailer court, apartment house, country club, youth club, school, camp, or similar establishment where the primary purpose of the establishment is not the operation of the swimming facilities. Semi-public outdoor, inground swimming pool shall also mean a pool constructed and maintained by groups for the purposes of providing bathing facilities for members and quests only. Refer to M.G.L. c. 140, § 206 for requirements pertaining to public or semi-public, outdoor, inground swimming pool enclosures, safety equipment, inspection, and penalties for violations.

Semi-public swimming pool, outdoor: Any semi-public swimming pool that is not defined as a semi-public outdoor, inground swimming pool.

Spa: See definition of private swimming pool.

Wading Pool: Aa pool of water in a basin having a maximum depth of less than two feet intended chiefly as a wading place for children. It does not include any residential pool as herein defined.

421.3 Permits and construction documents: A swimming pool or appurtenances thereto shall not be constructed, installed, enlarged or *altered* until *construction documents* have been submitted and a permit has been obtained from the code official. The approval of all city, county and state authorities having jurisdiction over swimming pools shall be obtained before applying to the code official for a permit. Certified copies of these approvals shall be filed as part of the supporting data for the permit application.

421.3.1 Construction documents: *Construction documents* shall accurately show dimensions and construction of the pool and appurtenances and properly established distances to *lot lines*, buildings, walks and fences, as well as details of the water supply system, drainage and water disposal systems, and all appurtenances pertaining to the swimming pool. Detailed *construction documents* of structures, vertical elevations and sections through the pool showing depth shall be included.

421.4 Locations: Private swimming pools shall not encroach on any front or side yard required by 780 CMR or by the governing zoning law, unless in accordance with specific rules of the jurisdiction in which the pool is located. A wall of a swimming pool shall not be located less than six feet (1829 mm) from any rear or side property line or ten feet (3048 mm) from any street property line, unless in accordance with specific rules of the jurisdiction in which the pool is located.

421.5 Structural design: The pool structure shall be engineered and designed to withstand the expected forces to which the pool will be subjected.

421.5.1 Wall slopes: To a depth up to two feet nine inches (838 mm) from the top, the wall slope shall not be more than one unit horizontal in five units vertical (l:5).

421.5.2 Floor slopes: The slope of the floor on the shallow side of the transition point shall not exceed one unit vertical to seven units horizontal (l:7). For public pools greater than 1,200 square feet (111.6 m^2), the slope of the floor on the shallow side of the transition point shall not exceed one unit vertical to ten units horizontal (l:l0). The transition point between shallow and deep water shall not be more than five feet (1524 mm) deep.

421.5.3 Surface cleaning: All swimming pools shall be provided with a recirculating skimming device or overflow gutters to remove scum and foreign matter from the surface of the water. Where skimmers are used for private pools, there shall be at least one skimming device for each l,000 square feet (93 m^2) of surface area or fraction thereof. For public pools where water skimmers are used, there shall be at least one skimming device for each 500 square feet (55.8 m^2) of surface area or fraction thereof. Overflow gutters shall not be less than three inches (76 mm) deep and shall be pitched to a slope of one unit vertical to 48 units horizontal (l:48) toward drains, and constructed so that such gutters are safe, cleanable and that matter entering the gutters will not be washed out by a sudden surge of entering water.

421.5.4 Walkways: All public *and semi-public* swimming pools shall have walkways not less than four feet (1219 mm) in width extending entirely around the pool. Curbs or sidewalks around any swimming pool shall have a slip-resistant surface for a width of not less than four foot (305 mm) at the edge of the pool, and shall be so arranged as to prevent return of surface water to the pool.

421.5.5 Steps and ladders: At least one *means of egress* shall be provided from private pools. ***All*** public ***and semi-public*** pools shall provide ladders to other *means of egress* at both sides of the diving section and at least one *means of egress* at the shallow section; or at least one *means of egress* in the deep section and the shallow section if diving boards are not provided. Treads of steps and ladders shall have slip-resistant surfaces and handrails on both sides, except that handrails are not required where there are not more than four steps or where the steps extend the full width of the side or end of the pool. ***(Refer to 521 CMR 19.00, the Architectural Access Board's rules and regulations, for requirements pertaining to the accessibility of all public and semi-public swimming pools.)***

421.6 Water supply: All swimming pools shall be provided with a potable water supply, free of cross connections with the pool or its equipment.

421.6.1 Water treatment: ***See 105 CMR 935.000 Minimum Standards for Swimming Pools.***

421.6.2 Drainage systems: The swimming pool and equipment shall be equipped to be emptied completely of water and the discharged water shall be disposed of in an approved manner that will not create a nuisance to adjoining property.

421.7 Appurtenant structures: All *appurtenant structures*, installations and equipment, such as showers, dressing rooms, equipment houses or other buildings and structures, including plumbing, heating and air conditioning systems, shall comply with all applicable requirements of 780 CMR, ***applicable zoning laws and requirements, 105CMR 435.000: Minimum Standards for Swimming Pools (State Sanitary Code: Chapter V), 248 CMR 2.00 : the State Plumbing Code, and 527 CMR 12.00: the State Electrical Code.***

421.7.1 Accessories: All swimming pool accessories shall be designed, constructed and installed so as not to be a safety hazard. Installations or structures for diving purposes shall be properly anchored to insure stability.

421.8 Equipment installations: Pumps, filters and other mechanical and electrical equipment for public swimming pools shall be enclosed in such a manner as to provide access only to authorized persons and not to bathers. Construction and drainage shall be arranged to avoid the entrance and accumulation of water in the vicinity of electrical equipment.

421.9 Enclosures for ***outdoor, inground*** **public** ***and semi-public*** **swimming pools**: *Outdoor, inground* public and *semi-public* swimming pools shall be provided with an enclosure ***in accordance with M.G.L. c. 140, § 206.***

421.9.1 Enclosure ***for public and semi-public outdoor, inground swimming pools***: ***Every public and semi-public outdoor, inground swimming pool shall be enclosed by a fence six feet in height and firmly secured at ground level provided that any board or stockade fence or structure shall be at least five feet in height, but if over five feet in height, the fence shall be chain link. Such enclosure, including gates therein, shall not be less than six feet above the ground, and any gate shall be self-latching with latches placed four feet above the ground or otherwise made inaccessible from the outside to children up to eight years of age. Such enclosure shall be constructed of such material and maintained so as not to permit any opening in said enclosure, other than a gate, wider than three inches at any point along the enclosure. Any such pool shall be equipped with at least one life ring and rescue hook.***

421.9.1.1 Enclosure for all other public and semi-public swimming pools: The enclosure shall extend not less than four feet (1219 mm) above the ground. All gates shall be self-closing and self-latching with latches placed at least four feet (1219 mm) above the ground.

421.9.2 Construction ***of enclosure for all other public and semi-public swimming pools***: Enclosure fences shall be constructed so as to prohibit the passage of a sphere larger than four inches (102 mm) in diameter through any opening or under the fence. Fences shall be designed to withstand a horizontal concentrated load of 200 pounds (91 kg) applied on a one-square-foot (0.093 m2) area at any point of the fence.

421.10 Enclosures for private swimming pools, spas and hot tubs: *In lieu of any zoning laws or ordinances to the contrary,* private swimming pools, spas and hot tubs shall be enclosed in accordance with 780 CMR 421.10.1 through 421.10.4 or by other approved barriers.

421.10.1 Outdoor private swimming pool: An outdoor private swimming pool, including an in-ground, above ground or on-ground pool, hot tub or spa shall be provided with a barrier which shall comply with the following.

1. The top of the barrier shall be at least 48 inches (1219 mm) above finished ground level measured on the side of the barrier which faces away from the swimming pool. The maximum vertical clearance between finished ground level and the barrier shall be two inches (51 mm) measured on the side of the barrier which faces away from the swimming pool. Where the top of the pool structure is above finished ground level, such as an above-ground pool, the barrier shall be at finished ground level, such as the pool structure, or shall be mounted on top of the pool structure. Where the barrier is mounted on top of the pool structure, the maximum vertical clearance between the top of the pool structure and the bottom of the barrier shall be four inches (102 mm).
2. Openings in the barrier shall not allow passage of a four-inch (102 mm) diameter sphere.
3. Solid barriers shall not contain indentations or protrusions except for normal construction tolerances and tooled masonry joints.
4. Where the barrier is composed of horizontal and vertical members and the distance between the tops of the horizontal members is less than 45 inches (1143 mm), the horizontal members shall be located on the swimming pool side of the fence. Spacing between vertical members shall not exceed 1¾ inches (44 mm) in width. Decorative cutouts shall not exceed 1¾ inches (44 mm) in width.
5. Where the barrier is composed of horizontal and vertical members and the distance between the tops of the horizontal members is 45 inches (1143 mm) or more, spacing between vertical members shall not exceed four inches (102 mm). Decorative cutouts shall not exceed 1¾ inches (44 mm) in width.
6. Maximum mesh size for chain link fences shall be a 1¼-inch (32 mm) square unless the fence is provided with slats fastened at the top or the bottom which reduce the openings to not more than 1¾-inches (44 mm).
7. Where the barrier is composed of diagonal members, such as a lattice fence, the maximum opening formed by the diagonal members shall be not more than 1¾ inches (44 mm).
8. Access gates shall comply with the requirements of 780 CMR 421.10.1 items 1 through 7, and shall be equipped to accommodate a locking device. Pedestrian access gates shall open outwards away from the pool and shall be self-closing and have a self-latching device. Gates other than pedestrian access gates shall have a self-latching device. Where the release mechanism of the self-latching device is located less than

54 inches (1372 mm) from the bottom of the gate: (a) the release mechanism shall be located on the pool side of the gate at least three inches (76 mm) below the top of the gate; and (b) the gate and barrier shall not have an opening greater than ½ inch (13 mm) within 18 inches (457 mm) of the release mechanism.

9. Where a wall of a dwelling serves as part of the barrier, one of the following shall apply:

9.1. All doors with direct access to the pool through that wall shall be equipped with an alarm which produces an audible warning when the door and its screen, if present, are opened. The audible warning shall commence not more than seven seconds after the door and screen door, if present, are opened and shall sound continuously for a minimum of 30 seconds. The alarm shall have a minimum sound pressure rating of 85 dBA at ten feet (3048 mm) and the sound of the alarm shall be distinctive from other household sounds such as smoke alarms, telephones and door bells. The alarm shall automatically reset under all conditions. The alarm shall be equipped with manual means, such as touchpads or switches, to deactivate temporarily the alarm for a single opening from either direction. Such deactivation shall last for not more than 15 seconds. The deactivation touchpads or switches shall be located at least 54 inches (1372 mm) above the threshold of the door.

9.2. The pool shall be equipped with an approved power safety cover.

10. Where an above-ground pool structure is used as a barrier or where the barrier is mounted on top of the pool structure, and the means of access is a fixed or removable ladder or steps, the ladder or steps shall be surrounded. by a barrier which meets the requirements of 780 CMR 421.10.1 items 1 through 9. A removable ladder shall not constitute an acceptable alternative to enclosure requirements.

421.10.2 Indoor private swimming pool: All walls surrounding an indoor private swimming pool shall comply with 780 CMR 421.10.1, item 9.

421.10.3 Prohibited locations: Barriers shall be located so as to prohibit permanent structures, equipment or similar objects from being used to climb the barriers.

421.10.4 Exemptions: The following shall be exempt from the provisions of 780 CMR 421.0.

1. A spa or hot tub with an approved safety cover.
2. Fixtures which are drained after each use.

421.11 Diving boards: Minimum water depths and distances for diving hoppers for pools, based on board height above water, shall comply with Table 421.11(1) for public pools and Table 421.11 (2) for private pools.

The maximum slope permitted between point D_2 and the transition point shall not exceed one unit vertical to three units horizontal (1:3) in private and public pools. D_1 is the point directly under the end of the diving boards. D_2 is the point at which the floor begins to slope upwards to the transition point. See Figure 421.11.

Figure 421.11
MINIMUM WATER DEPTHS AND DISTANCES BASED ON BOARD HEIGHT FOR *ALL* PUBLIC, *SEMI PUBLIC* AND PRIVATE POOLS

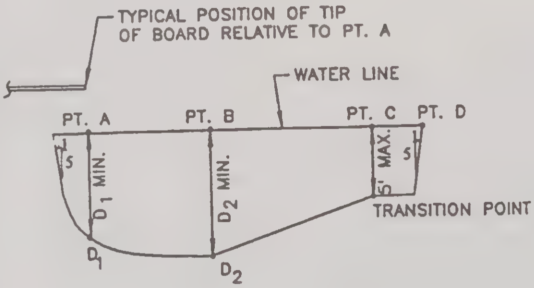


Table 421.11(1)
MINIMUM WATER DEPTHS AND DISTANCES BASED ON BOARD HEIGHT FOR *ALL* PUBLIC POOLS

Board height	Minimum depth[a] at D_1 directly under end of board	Distance[a] between D_1 and D_2	Minimum depth[a] at D_2
2'2" (⅔ meter)	7'0"	8'0"	8'6"
2'6" (¾ meter)	7"6"	9'0"	9'0"
1 meter	8'6"	10'0"	10'0"
3 meter	11'0"	10'0"	12'0"

Note a. 1 foot = 304.8 mm.

Table 421.11(2)
MINIMUM WATER DEPTHS AND DISTANCES BASED ON BOARD HEIGHT FOR PRIVATE POOLS

Board height	Minimum depth[a] at D_1 directly under end of board	Distance[a] between D_1 and D_2	Minimum depth[a] at D_2
1'8" (½ meter)	6'0"	7'0"	7'6"
2'2" (⅔ meter)	6'10"	7'6"	8'0"
2'6" (¾ meter)	7'5"	8'0"	8'0"
3'4" (1 meter)	8'6"	9'0"	9'0"

Note a. 1 foot = 304.8 mm.

780 CMR 422.0 EXISTING BUILDINGS

422.1 Existing Buildings*: See 780 CMR 34.*

422.2 Places of assembly

422.2.1 Change of use*: An existing building or structure or part thereof shall not be altered or* *converted into a place of assembly unless it complies with the provisions of 780 CMR 34 applicable to places of assembly.*

780 CMR 423.0 GROUP RESIDENCE

423.1 Scope: Except as may otherwise be specifically provided for in 780 CMR 423.0 , the requirements of 780 CMR, in its entirety, and as applicable, shall apply.

423.1.1 Department of Mental Retardation (DMR) Group Homes: 780 CMR 423.0 shall not apply to premises operated or licensed by the Department of Mental Retardation (DMR) pursuant to 115 CMR 7.00 and 8.00, upon the completion of a DMR safety assessment for each individual and an approved safety plan for each location where services and supports are provided. Such premises shall be treated as conventional R-4, R-3, R-2 and R-1 use as applicable.

***423.2 Definition**: A group residence is a premise licensed by or operated by an agency of the Commonwealth of Massachusetts or subdivision thereof, as a special residence for those who are capable of self-preservation in the following categories:*

1. *not more than 12 unrelated persons between the ages of seven and 15 years of age inclusive; or*
2. *not more than 25 unrelated persons, 16 years of age or over; or*
3. *a combination of 780 CMR 423.2 category 1 and 2 above consisting of not more than 18 unrelated persons over seven years of age calculated at the rate of two such persons, or portion thereof, from Category 2 being equal to one such person in Category 1 all in accordance with Table 423.2.*

***Note**: In determining the classification for proposed use, group residence shall not be construed as being similar in any way to a multi-family dwelling, two-family dwelling, boarding house, lodging house, dormitory, hotel, school or institution of any kind. For building code purposes, it shall be treated as a single-family residential building.*

Table 423.2
Group Residence - Maximum Capacity, Combination of Categories

Category Number	*Number of Residents per Category*												
Category 1	*12*	*11*	*10*	*9*	*8*	*7*	*6*	*5*	*4*	*3*	*2*	*1*	*0*
Category 2	*0*	*2*	*4*	*6*	*8*	*10*	*12*	*13*	*14*	*15*	*16*	*17*	*25*
Maximum total residents	*12*	*13*	*14*	*15*	*16*	*17*	*18*	*18*	*18*	*18*	*18*	*18*	*25*

***423.2.1 Special definitions:** For the purpose of 780 CMR 423.0, the following terms shall be defined exclusively for use with group residences:*

***Self preservation**: Having the capability, both mentally and physically, to take action to preserve one's own life. Specifically, to egress the building within 2½ minutes. (Reference inspection procedures in 780 CMR 423.8 and 423.9.)*

***Egress**: A continuous unobstructed path of travel from any space in a building to the open air outside at grade.*

***Principal means of egress**: The primary choice of two routes normally used by occupants to enter or leave a building.*

***Escape route**: To reduce the possibility of entrapment in the event that the principal means of egress is blocked by fire or smoke, an escape route shall be available which performs in accordance with 780 CMR 423.6 and 423.9. In an existing building where a second means of egress is physically impractical from above grade floors, any proven, usable path to the open air outside at grade shall be deemed acceptable, including but not limited to connecting doors, porches, windows within six feet of grade, ramps, fire escapes, balcony evacuation systems, etc.*

***Authorized inspectors**: The state or local building official having jurisdiction and a representative of the licensing or operating agency having jurisdiction.*

Room: See definition of "Habitable space" and "Occupiable room" in 780 CMR 201.0.

***423.3 Existing buildings:** The requirements of 780 CMR 423.0, shall also apply to existing dwelling units which are to be converted to a group residence and alternative requirements set forth in 780 CMR 34 that conflict with the requirements of 780 CMR 423.0 shall not apply.*

***423.3.1 Height limitations:** Existing buildings, of Type 5B construction, greater than 2½ stories, or 35 feet in height may be allowed to be used (as an exception to Table 503) as a group residence.*

***423.4 Plans and specifications:** Plans shall be filed with the building official having jurisdiction in accordance with 780 CMR 110.0 for any building to be constructed as, or altered for use as, a group residence under 780 CMR 423.0. The floor plans shall show all rooms, spaces, closets, doors, corridors, windows, stairs and stairways, hazardous vertical openings and the location of all required fire warning equipment and proposed fire suppression equipment.*

***423.5 Hazardous contents:** Any contents which represent a fire hazard greater than that which could be expected of ordinary household furnishings, shall not be allowed. Storage shall not be allowed above the second floor.*

423.5.1 Interior finish: *Only Class I and Class II interior finish materials shall be allowed in the principal means of egress. In refinishing any other area, material having a Class III flame spread rating shall be allowed provided it does not decrease the existing rating. The smoke contribution rating of any material shall not exceed 450 (see 780 CMR 704.0).*

423.5.2 Exception: *In existing buildings, the required flame spread or smoke development classification of interior surfaces may be obtained by applying approved fire retardant paints or solutions to existing interior surfaces having a higher flame spread rating than permitted.*

423.6 Egress: *In existing buildings there shall be one means of egress and one escape route serving each floor, remote as possible from each other and leading to grade. The stairway between the first and second floors, if unenclosed, may remain unenclosed to preserve functional and aesthetic requirements. In new construction, two means of egress are required in accordance with the One- and Two-Family Dwelling Code, and stairways above the grade floor shall be enclosed with one hour fireresistive construction.*

Exception:

1. *Where the Group Residence is protected with a fire suppression system according to NFiPA 13D or better as listed in Appendix A only one means of egress shall be required from floors above the grade floor in existing buildings and new construction.*
2. *Where the Group Residence is protected with a fire suppression system according to NFiPA 13D or better as listed in Appendix A the enclosure of stairways is not required.*

423.7 Fire protection systems

423.7.1 Hazardous vertical openings: *Openings to such spaces as laundry chutes, dumbwaiters, heating plenums or combustible concealed spaces shall be permanently blocked with one hour construction, as regulated by the provisions of 780 CMR 7.*

423.7.2 Automatic fire warning systems: *An approved automatic fire warning system shall be provided in accordance with 780 CMR 9.*

423.8 Inspections: *There shall be three mandatory types of inspections as described below. The results of such inspections shall be on file in the office of the building official with copies sent to the licensing or operating agency on a prepared checklist and signed by the authorized inspectors.*

423.8.1 Temporary certificate: *The building official shall perform plan review and post-construction inspection to ensure that the building conforms to 780 CMR. He shall issue a temporary certificate of occupancy effective for 90 days only.*

423.8.2 Final certificate: *Before issuance of the final certificate of occupancy, the authorized inspectors shall mutually conduct a test (see 780 CMR 423.9.1) to ensure that the occupants are capable of self-preservation. Upon complete satisfaction of all requirements, the building official shall then issue a permanent certificate of occupancy. This test shall be conducted once a year in accordance with 780 CMR 106.5 for purposes of recertifying both the building and the occupants.*

423.9 Inspection procedure: *The building and the occupants' capability of self-preservation constitute a system of life safety which are unique for each building and for each occupant in a group residence. Therefore, a simple direct test is specified herein to determine the capability of the occupant and/or the suitability of the building as a life safety system.*

423.9.1 Direct test/fire drill: *A fire drill shall be conducted as the direct test required by 780 CMR 423.9. The building official may require that he be present for the fire drill, or may accept an affidavit signed by the residence manager citing the names of the authorized inspectors present, the names of the occupants who participated, the name(s) of any occupants who failed to egress the building within 2½ minutes, the date, time and place where said fire drill was held. During the conduct of the drill, all staff personnel of the group residence shall isolate themselves from the occupants. The authorized inspector(s), when present, shall then cause to be blocked any one point in an egress route where the choice of an alternate route is possible, to simulate a hazardous condition, and the internal alarm system shall be activated for 2½ minutes.*

423.9.2 Evaluation: *Any occupant who fails to escape from the building and achieve egress outside the building at ground level within the 2½ minute period shall not be permitted to remain living in the residence.*

Note: The occupant or the building may be at fault; therefore, the system has failed to perform adequately to provide life safety and is, consequently, unacceptable for that occupant.

423.9.3 Other tests: *Other tests are not necessary and shall not be required by the building official. It shall be the responsibility of the residence manager of the group residence to provide immediate suitable accommodations elsewhere for any occupant deemed unacceptable by the building official. Each occupant must be certified at regular intervals but not less than every quarter at the group residence by the licensing or* *operating agency. The building official may require an inspection at his discretion when he feels that either the building or the occupant may not conform.*

423.10 Certificate of occupancy: *Any certificate of occupancy issued for a building intended to be used as a group residence, as defined in 780 CMR 423.2, shall become invalid if the premises have not been licensed or authorized by an agency of the Commonwealth of Massachusetts within 90 days of the date of issuance of the certificate of occupancy.*

780 CMR 424.0 DAY CARE CENTERS

424.1 General: *Day care centers in new or existing buildings shall be subject to the applicable provisions of 780 CMR and the special requirements of 780 CMR 424.0.*

424.2 Definitions:

Day Care Center: Special occupancies in which clients receive care, maintenance, and supervision by other than relatives or legal guardians for less than 24 hours per day. Such day care centers include both child day care centers and adult day care centers licensed by the office for children or other state agencies or otherwise functioning as a day care center.

Child Day Care Centers: Falling under the requirements of 780 CMR 424 and being a sub-set of day care centers, shall be those child day care centers so defined in 780 CMR 202.

Smoke Stop Partion: For purposes of 780 CMR 424.0, a smoke stop partion shall satisfy the requirements of 780 CMR 711.0 for a fire partion.

424.3 Use Group Classifications:

424.3.1 Less than two years and nine months in age: *Buildings and portions thereof licensed by the Office for Children as child day care centers for children two years and nine months in age or younger shall be classified as I-2 use group.*

424.3.2 More than two years and nine months in age: *Buildings or portions thereof licensed by the Office for Children as child day care centers for children more than two years and nine months in age shall be classified as E-use group.*

424.3.3 Adult Day Care Centers: *Buildings or portions thereof licensed by agencies of the state or otherwise operating as day care centers and otherwise not classified I-2 use or E-use shall be classified as B-use.*

Exception: *In adult day care centers in which clients and staff cannot evacuate the building with or without assistance in three minutes, such adult day care centers shall be classified in the I-2 category and subject to I-2 use provisions of 780 CMR 424.0.*

424.4 General Provisions:

424.4.1 Means of Egress: *Day Care Centers in new and existing buildings or portions thereof shall conform to the means of egress requirements as set forth in 780 CMR 10 and 780 CMR 34 as applicable and otherwise noted below in 780 CMR 424.0.*

424.4.1.1 Exit Signs and Means of Egress Lighting: *Exit signs and means of egress lighting shall conform to the requirements of 780 CMR 1023.0 and 1024.0 as applicable.*

424.4.1.2 Roof Egress: *Where the roof of a building is used as part of the day care center, required means of egress from the roof shall consist of two enclosed stairways: complying as exits and providing two separate protected ways of travel to exit discharges; or the required means of egress from the roof shall consist of one enclosed stairway complying as an exit providing a protected way of travel to an exit discharge and a protected stairway from the roof leading to a corridor on the floor directly below the roof and such corridor shall lead to two remote and independent exits. Stairways shall comply with the requirements of 780 CMR 10 except as noted on 780 CMR 424.4.2.*

424.4.1.2.1 Additional Roof Space Requirements: *Where a roof is used by a day care center, there shall be a solid, smooth non-climbable fence or barrier a minimum of seven feet high on all sides and separating the day care center area from any other uses. Fences shall be set back at least three feet from the outside edge of the exterior wall below. A waterproof telephone or equivalent means of communication shall be located on the roof for use in emergencies and shall be openable without keys, coins, or special knowledge.*

424.4.1.3 Doors: *All required means of egress doors shall be at least 36 inches in width. All other doors shall be at least 32 inches in width.*

Exception: *Where the occupant load, as calculated in accordance with 780 CMR 1008, requires door widths in excess of 36 inches; door widths shall conform to the requirements of 780 CMR 1017.3.*

424.4.1.4 Handrails: *Handrails shall conform to the requirements of 780 CMR 1022.0 and when the day care center clients include children, in addition to an upper handrail, a lower handrail shall be installed between 20" and 24" above the nosing of the stair tread.*

***424.4.1.5 Guards**: Guards shall conform to the requirements of 780 CMR 1021.0.*

***424.4.1.6 Stairways**: Stairways, whether required means of egress interior or exterior stairways or supplemental stairways, shall comply with the requirements of 780 CMR 1014.0 and 780 CMR 34.0 as applicable.*

> ***Exception**: Existing stairways shall not be required to satisfy the requirements of 780 CMR 1014.6 unless so required by the Building Official in accordance with 780 CMR 3400.4 or 3400.5.*

***424.4.2 Mixed Use- New and Existing Buildings**:*

***424.4.2.1 Mixed Use- New Construction**: In new construction mixed use buildings, day care centers shall conform to the separation requirements of 780 CMR 313.0.*

***424.4.2.2 Mixed Use- Existing Buildings**: In mixed use existing buildings the day care center walls shall conform to the separation requirements of 780 CMR 313.0 except that the floor - ceiling assemblies of the day care center for the 780 CMR 313.1.2 separation option shall, as a minimum, conform as follows:*

(a) For day care centers located above any usable space - the floor of the day care center shall have a minimum of a one hour fireresistance rating in buildings of Type 2C, 3B and 5 construction; and a minimum of a two hour fireresistance rating in buildings of type 1, 2A, 2B, 3A and 4 construction.

(b) For day care centers located below usable space, the ceiling of the day care center shall have at least a one hour fireresistance rating or the floor above shall be equipped with smoke detectors interconnected to the day care center fire warning system such that smoke detector activation on the floor above will initiate alarm in the day care center.

***424.4.2.3 Mixed Day Care Use**: When a day care center contains children or adults of mixed ages such that it would be classified in both I-2 and B or E and B use groups, the provisions for the most restrictive use shall apply unless the building or portion thereof satisfies the requirements set forth in 780 CMR 313.0.*

***424.4.3 Elevator Doors**: In buildings with elevators, the day care center:*

(1) shall not be exposed directly to the elevator doors opening from the elevator shaft,

(2) at least one of the required means of egress shall not be exposed to the elevator openings.

Elevator door openings may be separated by two hour fireresistance rated construction creating elevator lobbies and where such lobbies exist, of 780 CMR 424.4.3(1) and (2) are deemed satisfied.

***424.4.4 Fire Protective Signaling Systems**: Fire protective signaling systems shall be installed in all day care centers and shall conform to the requirements of 780 CMR 917.0.*

> ***Exception**: Residential occupancies identified in 780 CMR 424.4.5, Exception 1.*

***424.4.5 Automatic Fire Detection Systems**: An automatic fire detection system shall be designed and installed in accordance with the requirements of 780 CMR 918.0; 780 CMR 424.4.2.2(b); 780 CMR 424.4.5 and 780 CMR 424.5 as applicable.*

> ***Exception 1**: Residential occupancies that incorporate day care center I-2 or E- or B-Use and otherwise comply with all applicable requirements of 780 CMR 424, have a day care occupancy not exceeding 24 clients and otherwise do not have, nor are required to have, fire protection systems complying with 780 CMR 917 and 780 CMR 918 shall be permitted to utilize single and multiple station smoke detectors in accordance with 780 CMR 919. In such instances the requirements of 780 CMR 923.2 shall not apply.*
>
> ***Exception 2**: Single story buildings or portions thereof with day care occupancies not exceeding 24 clients and which otherwise comply with all applicable requirements of 780 CMR 424, specifically and 780 CMR generally, shall be required to utilize fire protection systems complying with 780 CMR 917 and 780 CMR 918, but the requirements of 780 CMR 923.2 shall not apply unless the building fire protection systems are otherwise required to conform to the requirements of 780 CMR 923.*
>
> *(**Note to Exception 2:** If the basement or cellar of such a building is used as a portion of the day care center, Exception 2 of 780 CMR 424.4.5 shall not apply).*

***424.4.5.1 Location of Detectors**: Smoke detectors shall be installed to ensure total coverage of the day care center and also located in front of the doors to the stairways and in the corridor providing required means of egress on all floors of the day care center, and comply with the smoke detector manufacturers listed requirements.*

***424.4.5.1.1 Zoning**: Specific smoke detector zoning shall be in accordance with 780 CMR 917.7.3 with smoke detectors spacing no greater than 30' unless otherwise allowed via manufacturer's listing requirements.*

***424.4.5.2 Compatibility**: Fire protection signaling systems and/or automatic fire detection systems that are interfaced shall* *be listed for such mechanical and electrical interfacing.*

***424.4.6 Story Height Limitations**: The allowed basement and story locations of day care centers in new and existing buildings shall be limited by the provisions of 780 CMR 424.5, as applicable to the use group classification of the day care center, and Table 780 CMR 424.4.6.*

Table 424.4.6
PERMITTED LOCATIONS AND REQUIRED SPRINKLER PROTECTION FOR DAY CARE CENTERS

<table>
<tr><td colspan="11"><i>I-2 Child Care Occupancy Children Under Two Years Nine Months of Age</i></td></tr>
<tr><td rowspan="2"><i>Floor Level of Child Day Care Center</i></td><td colspan="10"><i>Building Construction Type</i></td></tr>
<tr><td>1A</td><td>1B</td><td>2A</td><td>2B</td><td>2C</td><td>3A</td><td>3B</td><td>4</td><td>5A</td><td>5B</td></tr>
<tr><td><i>Basement / Cellar</i></td><td>P</td><td>P</td><td>P</td><td>P</td><td>P</td><td>P</td><td>P</td><td>P</td><td>P</td><td>P</td></tr>
<tr><td><i>1st Story</i></td><td>P</td><td>P</td><td>P</td><td>P</td><td>P</td><td>P</td><td>P</td><td>P</td><td>P</td><td>P</td></tr>
<tr><td><i>2nd Story</i></td><td>PS</td><td>PS</td><td>PS</td><td>S</td><td>NP</td><td>S</td><td>NP</td><td>S</td><td>NP</td><td>NP</td></tr>
<tr><td><i>3rd Story</i></td><td>PS</td><td>PS</td><td>PS</td><td>S</td><td>NP</td><td>S</td><td>NP</td><td>S</td><td>NP</td><td>NP</td></tr>
<tr><td><i>4th Story and Higher</i></td><td>NP</td><td>NP</td><td>NP</td><td>NP</td><td>NP</td><td>NP</td><td>NP</td><td>NP</td><td>NP</td><td>NP</td></tr>
<tr><td colspan="11"><i>E Child Care Occupancy / Children Over Two Years Nine Months of Age</i></td></tr>
<tr><td rowspan="2"><i>Floor Level of Child Day Care Center</i></td><td colspan="10"><i>Building Construction Type</i></td></tr>
<tr><td>1A</td><td>1B</td><td>2A</td><td>2B</td><td>2C</td><td>3A</td><td>3B</td><td>4</td><td>5A</td><td>5B</td></tr>
<tr><td><i>Basement / Cellar</i></td><td>P</td><td>P</td><td>P</td><td>P</td><td>P</td><td>P</td><td>P</td><td>P</td><td>P</td><td>P</td></tr>
<tr><td><i>1st Story</i></td><td>P</td><td>P</td><td>P</td><td>P</td><td>P</td><td>P</td><td>P</td><td>P</td><td>P</td><td>P</td></tr>
<tr><td><i>2nd Story</i></td><td>P</td><td>P</td><td>P</td><td>P</td><td>P</td><td>P</td><td>P</td><td>P</td><td>P</td><td>P</td></tr>
<tr><td><i>3rd Story</i></td><td>PS</td><td>PS</td><td>PS</td><td>S</td><td>NP</td><td>S</td><td>NP</td><td>S</td><td>NP</td><td>NP</td></tr>
<tr><td><i>4th Story</i></td><td>PS</td><td>PS</td><td>PS</td><td>S</td><td>NP</td><td>S</td><td>NP</td><td>S</td><td>NP</td><td>NP</td></tr>
<tr><td><i>5th to 7th Story</i></td><td>PS</td><td>PS</td><td>PS</td><td>NP</td><td>NP</td><td>NP</td><td>NP</td><td>NP</td><td>NP</td><td>NP</td></tr>
<tr><td><i>8th Story and Higher</i></td><td>NP</td><td>NP</td><td>NP</td><td>NP</td><td>NP</td><td>NP</td><td>NP</td><td>NP</td><td>NP</td><td>NP</td></tr>
<tr><td colspan="11"><i>B - Day Care Occupancy / Adult (Elder) Day Care</i></td></tr>
<tr><td rowspan="2"><i>B-Use day care Facilities are not limited in where they may be located in a building</i></td><td colspan="10"><i>Exception (1):</i>
<i>Adullt day care centers falling under the "Exception" to 780 CMR 424.3.3</i></td></tr>
<tr><td colspan="10"><i>Exception (2):</i>
<i>Adult day care centers of mixed-care use as described in 780 CMR 424.4.2.3</i></td></tr>
</table>

Key to Table

P = Permitted
NP = Not Permitted
S = Sprinklers Required / See 780 CMR 424.5 for Special Provisions
PS = Partial Sprinklers Required / See 780 CMR 424.5 for Special Provisions

***424.4.7 Heating System**: Any portable or permanent heater in spaces occupied by clients shall be separated from the occupied space by partitions, guards, screens, or other means. Space and unit heaters using combustible fuels shall be prohibited. (Also see 424.4.8)*

***424.4.8 Boiler Rooms**: Boilers, furnaces or other fire units shall be enclosed as required in the BOCA National Mechanical Code listed in Appendix A. Boiler room doors shall not open into occupied areas.*

***424.4.9 High Hazard Restrictions**: A day care center shall not occupy the same building with, or be located within 200 feet of a high hazard occupancy.*

***424.4.10 Accessibility for Persons with Disabilities**: Accessibility requirements shall be in accordance with 521 CMR as listed in Appendix A.*

424.5 Special Provisions:

***424.4.5.1 Application**: Special provisions for I-2, E and B use day care centers and relating to allowed location, special egress and special alarm requirements are found in 780 CMR 424.5*

424.5.2 I-2 Use Allowed Basement/Cellar/Story Locations: In new and existing buildings, day care centers which are classified in the I-2 use group shall comply with one of the following compliance options listed below. All required means of egress for day care centers classified in use group I-2 shall lead directly to grade.

1. ***The location of the day care center shall be limited to the first floor, cellar and/or basement; or***
2. ***In buildings of Type 2B, 3A or 4 construction which are fully sprinklered and comply with the special provisions of 780 CMR 424.5.4.4, the day care center shall be located no higher than the third floor; or***
3. ***In buildings of Types 1A, 1B or 2A construction and are either fully sprinklered, or in which the day care center and all floors below are sprinklered, the day care center shall be located no higher than the third floor.***

Notes:

(1) Also see 780 CMR Table 424.4.6.
(2) See special egress requirements of 780 CMR 424.5.4.

424.5.3 E-Use Allowed Basement/Cellar/Story Locations: In new and existing buildings, day care centers which are classified in the E use group shall comply with one of the following compliance options listed below. All required means of egress for day care centers classified in use group E shall lead directly to grade.

1. ***The location of the day care center shall be limited to the second floor; first floor or cellar and/or basement, or;***
2. ***In buildings of Type 2B, 3A or 4 construction which are fully sprinklered and comply with the special provisions of Section 780 CMR 424.5.4.4, the day care center shall be located no higher than the fourth floor; or;***
3. ***In buildings of Types 1A, 1B or 2A construction which comply with the special provisions of 780 CMR 424.5.4.4 and are either fully sprinklered, or in which the day***

care center and all floors below are sprinklered, the day care center shall be located no higher than the seventh floor.

Notes:

(1) Also see 780 CMR Table 424.4.6.

(2) See special egress requirements of 780 CMR 424.5.4.

*424.5.4 B-Use Allowed Basement/Cellar/Story **Locations**: In day care centers classified in the B-Use category and where staff and clients in an emergency can exit the building in no more than three minutes, with or without assistance, there is no restriction on locating of the day care center within any basement/cellar or story.*

***Exception:** In adult day care centers classified as day care I-2 use see 780 CMR 424.3.3.*

*424.5.4 I-2 and **E Use Egress Requirements For Basement and Cellar Use:***

424.5.4.1 Basement or Cellar Use: A basement or cellar, as defined in 780 CMR 2, of a building of Type 3B or 5B construction may be used for a day care center in accordance with the following requirements:

1. There shall be two separate and independent means of egress, remote from each other and leading directly to grade, or;

2. there shall be two separate and independent means of egress, remote from each other and leading to two one hour fire-rated enclosed stairways not more than four feet in height vertically which lead directly to grade and are separated from any other use as an egress by one hour fire-rated partitions and self-closing doors, or;

3. A combination of 1 and 2.

424.5.4.2 Fire Protective Systems: Fire protection systems shall comply with the requirements of 780 CMR 424.4.4 and 424.4.5; additionally in basement or cellar use, regardless of building construction type, smoke detectors shall be located in the first story above the basement or cellar location and in any story below grade that may exist below the basement or cellar day care location. Such smoke detectors shall be connected to the day care automatic fire detection system.

*424.5.4.3 Common Corridor Exit Access in **Buildings** of Types 1, 2A and 2B **Construction**: In buildings equipped with a fire suppression system in conformance with 780 CMR 9, a common exit access corridor shall be acceptable for providing access to two means of egress required in 780 CMR 424.4.1, such common corridors used for exitway access may be subdivided, to provide separate and independent exitway access by using smoke stop partions complying, as applicable, with the provisions of 780 CMR 711.0 for fire partitions. Access through interconnected rooms to either side of the smoke stop partition, as provided in 780 CMR 424.4, shall be allowed as a method of complying with 780 CMR 424.5.4.3. If the doors in the smoke stop partitions are normally open, such doors shall be equipped with an automatic hold open device, actuated by either the building fire protective signaling system and/or the building automatic fire detection system to close automatically.*

*424.5.4.4 I-2 and E use Day Care Centers **Located** in Upper Stories of a Building: In new and existing buildings containing I-2 day care occupancies where the day care center is located above the first floor, and in new and existing buildings containing E use day care occupancies and where the day care center is located above the third floor, the day care center shall meet also the requirements of 780 CMR 424.5.4.5 thru 780 CMR 424.5.4.7.*

424.5.4.5 Telephone communication: The day care center shall have telephones located in every occupied room of the day care center and directly connected to the building fire command center or to a constantly attended station within the building, if such exists, or otherwise such telephones shall utilize standard phone service with such phones having the capability of retaining, and upon manual selection, automatically dialing the emergency number of the fire department having jurisdiction.

*424.5.4.6 **Alarm requirements**: In addition to the requirements of 780 CMR 424.4.4 and 424.4.5, on the floor of the day care center and/or the floor below, the operation of any water flow device, manual pull station, smoke or heat detector will initiate a special announcement for the day care center to evacuate or proceed to a specific area. The language of the announcement shall be acceptable to the building official and head of the fire department. Smoke detectors shall be installed on the ceiling of the floor below the day care center. Manual pull stations shall be required on the floor located below the care center.*

424.5.4.7 Areas of refuge: In new and existing buildings containing E use care occupancies where the day care center is located on the fourth through seventh floors, the day care center shall have direct access to a separate area which shall have a minimum of two hour fireresistance rated construction separating it from the rest of the building. The area shall adjoin an enclosed stairway with a fire *resistance rating of at least two hours. The area shall be sized at nine square feet per person to accommodate the licensed client capacity and staff of the day care center. This provision shall apply to all centers located on the sixth or seventh floors of a building and to those centers on the fourth or fifth floors whose licensed capacity exceeds 50 clients. (Also see Table 424.4.6.)*

780 CMR 425.0 SUMMER CAMPS FOR CHILDREN

425.1 Definition: Summer camps for children include premises, operated solely between April and October of each year for recreational or other purposes, and having residential facilities. The use of such accommodations for purposes of inspection, certification and inspection fees shall be considered as being similar to a dormitory in Use Group R-2 and subject to the following provisions of 780 CMR 425.0

425.2 New and existing occupancies: 780 CMR 425.0 shall apply to existing and new summer camps for children as defined in 780 CMR 425.1.

425.3 Means of egress: All one-story, one-room buildings having 1,000 square feet or less and having 25 occupants or less shall require only one means of egress provided that:

1. *the length of travel does not exceed 50 feet from any point in the building to the outside at grade; and,*
2. *the minimum width for aisles and corridors shall be three feet.*

425.3.1 Emergency escape: Every sleeping room shall have at least one exterior door or openable window to permit emergency exit or rescue; the windows shall conform to the following restrictions:

1. *must be openable from the inside without the use of separate tools;*
2. *the sill height shall not be more than 36 inches above the finish floor and with a maximum six foot drop from the window sill to grade below the window; and*
3. *provide a minimum net clear opening area 5.7 square feet. The minimum net clear opening height dimension shall be 24 inches, The minimum net clear opening width dimension shall be 20 inches.*

425.4 Fire protection: Smoke detectors shall be required for existing and new residential units in accordance with 780 CMR 918.0 (919.0) of 780 CMR .

***Exception:** Tents and other temporary shelters which are designed to sleep less than eight persons and which have an open side consisting of greater than 1/6 of the perimeter of the shelter or which have built-in provisions for emergency escape.*

425.5 Mechanical: If camps are heated, then the building must conform to all applicable code sections and specialized codes, notwithstanding any of the provisions in 780 CMR 425.0.

*425.6 **Enforcement and inspections:** Enforcement shall be by the local building official who shall inspect and certify the summer camps yearly, prior to season opening. Fees charged shall be in accordance with 780 CMR.*

780 CMR 426.0 BULK MERCHANDISING RETAIL BUILDINGS

426.1 General: Bulk Merchandising Retail Buildings have different fire and life safety risks than traditional retail buildings. This difference requires special attention to fire protection and life safety. The purpose of 780 CMR 426.0 is to provide standards to adequately deal with these differences, and to reduce the risk of life loss, injury, and excessive property damage from fire.

426.2 Scope: The provisions of 780 CMR 426.0 shall apply to buildings or structures defined herein as Bulk Merchandising Retail Buildings or portions thereof containing high piled combustible storage as defined in 780 CMR 426.2.1. Unless otherwise noted in 780 CMR 426.0, the requirements for Bulk Merchandising Retail Buildings shall be in accordance with the requirements set forth for Use Group M, Mercantile as defined in 780 CMR 309.0 or 780 CMR 417.0 (if applicable).

426.2.1 Definitions: Terms used in 780 CMR 426.0 shall have the following meanings:

Aerosol: A product that is dispensed from a metal can, up to a maximum size of 33.8 fl oz (1000 ml) or a glass or plastic bottle, up to a maximum size of four fl oz (118 ml) that is designed and intended to dispense an aerosol by a propellant. Aerosols shall be classified by means of the calculation of their chemical heats of combustion and shall be designated Level 1, Level 2, or Level 3 in accordance with Table 426.2.

Table 426.2
AEROSOL CLASSIFICATION

Chemical Heat of Combustion	*Aerosol Level*
0-8,600 BTU/lb (0-20 kJ/g)	*1*
8,600-13,000 BTU/lb (20-30 kJ/g)	*2*
13,000 or greater BTU/lb (30 or greater kJ/g)	*3*

Group A Plastics: Products that utilize plastic, or non plastic products that utilize significant *plastic packaging materials, that have a high BTU content; ABS (acrylonitrile-butadiene-styrene copolymer), Acetal (polyformaldehyde), Acrylic (polymethyl methacrylate), Butyl rubber, EPDM (ethylene-propylene rubber), FRP (fiberglass reinforced polyester), Natural rubber (expanded), Nitrile rubber (acrylonitrile-butadiene rubber), PET or PETE (polyethylene terephthalate), Polybutadiene, Polycarbonate, Polyester elastomer, Polyethylene, Polypropylene, Polystyrene (expanded and unexpanded), Polyurethane (expanded and unexpanded), PVC (polyvinyl chloride greater than 15% plasticized, e.g., coated fabric unsupported film), SAN (styrene acrylonitrile), SBR (styrene-butadiene rubber).*

Bulk Merchandising Retail Buildings: A building where sales areas contain high piled combustible commodities, or high piled, high hazard commodities as defined by 780 CMR 4 and 780 CMR 3.

Combustible Liquids: Any liquids having a flashpoint at or above 100 °F (38 °C) shall be known as Class II or III liquids. Combustible liquids shall be divided into the following classification:

Class II - Liquids with a flash point at or above 100 °F (37.8 °C) and below 140 °F (60 °C).

Class III-A - Liquids with a flash point at or above 140 °F (60 °C) and below 200 °F (93.3 °C).

Class III-B - Liquids with a flash point at or above 200 °F (93.3 °C).

Control Area: Is a building or portion of a building within which the exempted amounts of hazardous materials are allowed to be stored, dispensed, used, or handled.

Corrosive: A chemical that causes visible destruction of, or irreversible alterations in tissue by chemical action at the site of contact. A chemical is considered to be a corrosive if, when tested on the intact skin of albino rabbits by the method described in Appendix A of CFR 49, Part 173, it destroys or changes irreversibly the structure of the tissue at the site of contact following an exposure period of four hours. This term does not refer to action on inanimate surfaces. [Source: Uniform Fire Code]

Flammable Liquids: Any liquids having a flash point below 100 °F (38 °C), and having a vapor pressure not exceeding 40 psia (276 kPa) at 100 °F (38 °C). Flammable liquids shall be known as Class I liquids and shall be divided into the following classification:

I-A Liquid - A liquid with a flash point below 73 °F (22.8 °C) and a boiling point below 100 °F (37.8 °C).

I-B Liquid - A liquid with a flash point below 73 °F (22.8 °C) and a boiling point at or above 100 °F (37.8 °C).

I-C Liquid - A liquid with a flash point at or above 73 °F (22.8 °C) and below 100 °F (37.8 °C).

High Piled Combustible Commodity: Storage of combustible materials in piles greater than 12 feet (3.658 m) in height or combustible materials on pallets, in racks or on shelves where the top of storage is greater than 12 feet (3.658 m) in height.

High Piled, High Hazard Commodity: Storage of combustible materials such as rubber tires, Group A plastics, flammable liquids, idle pallets and commodities with similar heat release characteristics where the top of storage is greater than six feet (1.829 m) in height.

Highly Toxic: Material which produces a lethal dose or lethal concentration which falls within any of the following categories.

1. A chemical or substance that has a median lethal dose (LD50) of 50 milligrams or less per kilograms of body weight when administered orally to albino rats weighing between 200 and 300 grams each.

2. A chemical or substance that has a median lethal dosage of more than 200 milligrams or less per kilogram of body weight when administered by continuous contact for 24 hours, or less if death occurs within 24 hours, with bare skin of albino rabbits weighing between two and three kilograms each.

3. A chemical or substance that has a median lethal concentration (LC50) in air of 200 parts per million by volume of gas or vapor, or two milligrams per liter or less of mist, fume or dust, when administered by continuous inhalation for one hour, or less if death occurs within one hour, to albino rats weighing between 200 and 300 grams each.

Mixtures of these materials with ordinary materials, such as water, might not warrant classification as highly toxic. While this system is basically simple in application, any hazard evaluation which is required for the precise categorization of this type of material shall be performed by experienced, technically competent persons.

Oxidizer: A chemical other than a blasting agent or explosive that initiates or promotes combustion in other materials, thereby causing fire either of itself or through the release of oxygen or other gases.

Class 1: An oxidizer whose primary hazard is a slight increase in the burning rate but which does not cause spontaneous ignition when the *oxidizer comes in contact with combustible materials.*

Class 2: An oxidizer that will cause a moderate increase in the burning rate or that is capable of causing spontaneous ignition of combustible materials with which the oxidizer comes in contact.

Class 3: An oxidizer that will cause a severe increase in the burning rate of combustible materials with which the oxidizer comes in contact or that will undergo vigorous self-sustained decomposition due to contamination or exposure to heat.

Class 4: An oxidizer that is capable of an explosive reaction due to contamination or exposure to thermal or physical shock. Additionally, the oxidizer will enhance the burning rate and is capable of causing spontaneous ignition of combustibles. [Source: BOCA]

Rack Storage: Combination of vertical, horizontal and diagonal members that support stored materials in fixed or portable racks.

Shelf Storage: Storage on structures less than 30 in. (76.2 cm) deep with shelves usually two ft (0.6 m) apart vertically and separated by approximately 30 in. (76.2 cm) aisles.

Toxics: A material which produces a lethal dose or lethal concentration within any of the following categories:

1. A chemical or substance that has a median lethal dose (LD50) of more than 50 milligrams per kilograms but not more than 500 milligrams per kilograms of body weight when administered orally to albino rats weighing between 200 and 300 grams each.

2. A chemical or substance that has a median lethal dosage of more than 200 milligrams per kilogram but not more than 1,000 milligrams per kilogram of body weight when administered by continuous contact for 24 hours , or less if death occurs within 24 hours, with bare skin of albino rabbits weighing between 2 and 3 kilograms each.

3. A chemical or substance that has a median lethal concentration (LC50) in air more than 200 parts per million but not more than 2,000 parts per million by volume of gas or vapor, or more than two milligrams per liter but not more than 20 milligrams per liter of mist, fume or dust, when administered by continuous inhalation for one hour, or less if death occurs within one hour, to albino rats weighing between 200 and 300 grams each.

Unstable (Reactive): A chemical which in the pure state, or as produced or transported, will vigorously polymerize, decompose, condense or become self-reactive under conditions of shock, pressure or temperature.

Water Reactive Material: Material which explodes; violently reacts; produces flammable, toxic or other hazardous gases; or evolves enough heat to cause self-ignition or ignition of nearby combustibles upon exposure to water or moisture.

426.3 Commodity Classification: Commodities in storage and display shall be classified in accordance with the following NFPA Standards as listed in Appendix A.

13: Installation of Sprinkler Systems
30: Flammable and Combustible Liquids Code
30B: Aerosol Products, Manufacture and Storage
231: General Storage
231C: Rack Storage of Materials
231D: Storage of Rubber Tire
430: Storage of Liquid and Solid Oxidizers

426.4 Fire Protection Requirements: Fire protection requirements shall be in accordance with Table 426.4.

Table 426.4.
FIRE PROTECTION REQUIREMENTS

Commodity Class[1]	Size of High-Piled Display Area[2] (sq ft) x 0.0929 for m^2	Fire Protection Requirements				
		Fire Suppression System (780 CMR 426.5)	Fire Alarm/Notification (780 CMR 426.14)	Fire Department Access Doors (780 CMR 426.8)	Hose Connections (780 CMR 426.7)	Manual Smoke and Heat Vents (780 CMR 426.16
I-IV	0 - 2,500	NR	NR	NR	NR	NR
	2,501 - 12,000	Yes	NR	NR	NR	NR
	over 12,000	Yes	Yes	Yes	Yes	Yes
High Hazard	0 - 500	NR	NR	NR	NR	NR
	501 - 2,500	Yes	NR	NR	NR	NR
	2,501 - 12,000	Yes	NR	Yes	Yes	NR
	over 12,000	Yes	Yes	Yes	Yes	Yes

NR = Not required.

1. For commodity classifications definitions, see 426.3.

2. Areas that are separated by 60 ft of display area with such areas not used for high piled storage, or that are separated with a one-hour fireresistance-rated separation barrier, can be considered as separated high piled areas.
3. If the building is required to be sprinklered under 780 CMR, then the sprinkler system protecting the high piled storage area and 15 ft beyond shall be designed in accordance with the appropriate NFPA Standard(s).

426.5 Fire Suppression Systems: Fire sprinkler design and installation shall be provided in accordance with the applicable requirements set forth by NFPA 13, 30, 30B, 231, 231C, 231D, 430, as listed in Appendix A, or other nationally recognized codes and standards, or tests conducted in test laboratories as defined in 527 CMR 49.03, Appendix C as listed in Appendix A.

426.6 Storage Arrangement: Storage arrangements for fire protection purposes shall comply with requirements set forth by NFPA 13, 30, 30B, 231, 231C, 231D, 430, as listed in Appendix A, or other nationally recognized codes and standards, or tests conducted in test laboratories as defined in 527 CMR 49.03, Appendix C, as listed in Appendix A.

426.7 Hose Connections: A Class I automatic, wet-standpipe system shall be provided in accordance with NFPA 14. Hose connections shall be located around the interior perimeter of the building within five ft of all required fire department access doors, adjacent to the latch side of the door. Hose connections shall be installed to accommodate 200 ft of travel distance to any point in the building. Where the most remote portion of the building exceeds 200 ft of travel distance from the required access doors, additional hose connections shall be provided in locations approved by the head of the fire department. Hose connections shall be readily accessible and marked for fire department use only. When approved by the head of the fire department, the following exceptions shall be permitted.

> *Exception 1: Hose connections may be omitted when the following fire department building access and fire hydrant coverage is provided: minimum 18 ft wide, unobstructed access roadways located within 20 ft of the building on at least three sides; minimum ten ft wide, unobstructed access route between the access roadway and the fire department access doors; and, fire hydrants in locations approved by the head of the fire department.*
>
> *Exception 2: In lieu of a Class I standpipe system, a Class II automatic, wet-standpipe system in accordance with NFPA 14 shall be permitted when the following fire department building access and fire hydrant coverage is provided: minimum 18 ft wide, unobstructed access roadways located within 50 ft of the building on at least three sides; minimum ten ft wide, unobstructed access route between the access roadway and the fire department access doors; and, fire hydrants in locations approved by the head of the fire department. The hose connections shall be located as described above for the Class I standpipe system. Occupant hose shall not be required, and the hose connections shall be marked for fire department use only.*

426.8 Fire Department Access Door: Fire department access doors shall be provided for fire department emergency access. Access doors shall be:

1. *located adjacent to fire department access roadways,*
2. *provided with an approved exterior fire department accessible key cylinder operable lock device,*
3. *provided with approved fire department identification signs, and*
4. *provided such that all points of the floor area are accessible within 200 feet of travel distance.*

Fire department access doors may be used as occupant egress doors.

426.9 Fire Department Access Roadways: Fire department access roadways shall be provided on at least two sides of the building with such access to be approved by the head of the fire department prior to any construction. Fire hydrants shall be provided in locations approved by the head of the fire department.

426.10 Means of Egress: Means of egress shall be in accordance with the requirements set forth in 780 CMR 10 for Use Group M, Mercantile unless otherwise modified herein:

> *Exception: Exit access travel distance shall be limited to 200 feet.*

If the only means of customer entrance is through one exterior wall of the building, two thirds of the required egress width shall be located in this wall. At least one half of the required exits shall be located so as to be reached without passing through checkout stands. In no case shall checkout stands or associated railings or barriers obstruct exits, required aisles, or approaches thereto.

426.11 Flammable/Combustible Liquids: The display, storage, protection, and maximum allowable quantities of flammable and combustible liquids permitted in mercantile display areas shall be in accordance with NFPA 30, as listed in Appendix A.

426.12 Aerosols: The display, storage, protection, and maximum allowable quantities of aerosols permitted in mercantile occupancies shall be in accordance with of NFPA 30B.

Table 426.13.
DENSITY FACTOR FOR HAZARDOUS MATERIALS EXEMPTION CALCULATIONS.

Material	*Class*	*Solids pounds*[1] *(cubic feet)*	*Liquid gallons*[1] *(pounds)*	*Gas cubic feet*[1]
		x 0.4536 for kg (x 28.32 for liters)	*x 3.78 for liters (x 0.4536 for kg)*	*x 28.32 for liters*
Oxidizers	*4*	*Not permitted*	*Not Permitted*	*Not Permitted*
	3	*0.75*	*(0.75)*	*112.5*
	2	*1.5*	*(1.5)*	*9*
	1	*12*	*(12)*	*4.5*
Unstable (reactive)	*4*	*Not Permitted*	*Not Permitted*	*Not Permitted*
	3	*0.375*	*(0.375)*	*3.75*
	2	*0.3*	*(0.3)*	*1.5*
	1	*Unlimited*	*Unlimited*	*2.25*
Toxics	*All*	*0.65*	*(0.65)*	*1.053*
Corrosives	*All*	*6.5*	*0.65*	*1.053*
Highly Toxic	*All*	*0.0013*	*(0.0013)*	*0.026*
Water Reactive	*3*	*0.375*	*(0.0375)*	*Not Applicable*
	2	*0.3*	*(0.3)*	
	1	*0.375*	*(0.375)*	

1. Quantities may be increased by 100% in sprinklered buildings

426.13 Non-flammable and non-combustible hazardous materials: Non-flammable and non-combustible hazardous materials such as: Oxidizers, Unstable Materials, Toxics, Highly Toxics, Corrosives, and Water Reactives shall meet the following requirements:

$$Q = F \times A$$

where:

Q = the maximum quantity in a single control area for mercantile display.

F = the density factor as indicated in Table 426.13.

A = the area occupied for mercantile display. For computation purposes, the area shall not exceed 1,500 square feet (139.39 m^2*) per control area.*

426.14 Fire Alarm or Notification Systems: Either a fire alarm system or emergency notification system, as described below and approved by the head of the fire department, shall be provided:

1. Fire Alarm System: The fire alarm system shall include the following:

a. A fire alarm system required for life safety shall be installed, tested, and maintained in accordance with applicable requirements of NFPA 70 and 72, as listed in Appendix A.

b. All systems and components shall be approved for the purpose for which installed, and all installation wiring or other transmission paths shall be monitored for integrity in accordance with NFPA 72, as listed in Appendix A.

c. Manual fire alarm stations shall be provided in the natural path of escape near each required exit from an area. Each manual fire alarm station shall be accessible, unobstructed, visible, and of the same general type.

d. Notification signals for occupants to evacuate shall be by audible and visible signals in accordance with NFPA 72 and CABO/ANSI A117.1, as listed in Appendix A. The general evacuation alarm signal shall operate throughout the entire building.

e. The fire alarm system shall be arranged to transmit the alarm automatically via any of the following means acceptable to head of the fire department and in accordance with NFPA 72:

- *i. Auxiliary Alarm System*
- *ii. Central Station Connection*
- *iii. Proprietary System, or*
- *iv. Remote Station Connection.*

f. The fire alarm control panel location shall be located in an area acceptable to the head of the fire department. Where required, a remote annunciator shall be located in an area acceptable to the head of the fire department.

g. Other control systems intended to make the protected premises safer for building occupants including, but not limited to, duct smoke detectors, fire/smoke dampers, smoke management systems, fire door controls, shall be installed and monitored for integrity in accordance with NFPA 72, as listed in Appendix A, and a distinctive supervisory signal shall be provided to indicate a condition that would impair the satisfactory operation of the equipment.

h. Supervisory attachments including, but not limited to, control valves, fire pump running conditions, float valves, shall be installed and monitored for integrity in accordance with NFPA 72 as lisctd in Appendix A, and a distinctive supervisory signal shall be provided to indicate a *condition that would impair the satisfactory operation of the equipment.*

i. All building HVAC fans shall be arranged to automatically shut down on any general alarm condition. Duct smoke detectors shall not be required.

j. Waterflow initiating devices shall be arranged to initiate an alarm condition within one minute of being activated. In addition, provisions shall be made to control and prevent false alarms due to water surges.

2. Emergency Notification System: During a fire emergency, the emergency notification system shall sound an audible alarm in a continuously attended location for the purpose of initiating the evacuation plan required under 780 CMR 426.15.

426.15 Evacuation Planning and Training: An evacuation plan shall be submitted at the time of application for a building permit as part of the required documentation pursuant to 780 CMR 1. The Certificate of Use and Occupancy shall not be issued until the evacuation plan has been reviewed and approved by the head of the fire department. Any changes to the evacuation plan shall not be effected until a revised plan has been submitted to and approved by the head of the fire department. The evacuation plan shall detail procedures, define roles and responsibilities of employees, and shall include an egress plan indicating routes of travel to all exits. The evacuation plan shall be used to ensure the safe evacuation of all customers and employees. All employees shall be instructed and periodically trained with respect to their duties, as required by 527 CMR 10.25, as listed in Appendix A.

426.16 Smoke and Heat Venting: Adequate methods of manual heat and smoke venting shall be provided. The method of operation, vent area, spacing layout, construction of vents and curtain boards or other acceptable means of addressing methods of heat and smoke venting shall be determined by an engineering evaluation and analysis. The analysis shall be reviewed and approved by the head of the fire department and shall contain sufficient detail to evaluate the hazard and effectiveness of the venting system.

780 CMR 427.0 LIMITED GROUP RESIDENCE

*427.1 **General:** A building licensed by or operated by the Department of Mental Health or the Office for Children, Commonwealth of Massachusetts as a limited group residence: this is a special residence to include residents not capable self-preservation.*

427.1.1 Scope: A limited group residence shall have a maximum of 12 residents who are at least four years of age. Not more than four of the residents shall be impaired; provided, however, that more than four such residents may be impaired if the structure complies with 780 CMR 427.2. A limited group residence shall be classified in the R-5 use category for code purposes.

427.1.1.1 Department of Mental Retardation (DMR) Group Homes: 780 CMR 427.0 shall not apply to premises operated or licensed by the Department of Mental Retardation (DMR) pursuant to 115 CMR 7.00 and 8.00, upon the completion of a DMR safety assessment for each individual and an approved safety plan for each location where services and supports are provided. Such premises shall be treated as conventional R-4, R-3, R-2 and R-1 use as applicable.

427.1.2 Definitions: The following terms shall have the meaning indicated for the purpose of 780 CMR 427.0:

***Existing** building or structure: Any completed building or structure which has been legally occupied and/or legally used for a period of at least five years. Structures which fail to qualify with this definition shall comply with 780 CMR 427.2.*

Resident: A client in need of care who resides in the limited group residence of the licensing or operation agency. Staff are not considered as residents under the provisions of 780 CMR 427.0. The licensing agency shall classify all residents in one of the following three categories:

***Impaired:** All residents not capable of self-preservation through physical, mental and/or developmental disability and requiring physical assistance to exit the building. All residents under seven years of age shall be classified as impaired.*

***Partially** impaired: All residents physically, mentally and/or developmentally disabled but capable of exiting the limited group residence with either supervision and/or instruction without any physical assistance.*

***Unimpaired:** All residents capable of exiting the building without physical assistance and/or supervision or instruction by staff personnel and capable of negotiating any exitway of the limited group residence.*

***427.1.3** Application of building code and **reference:** Except as may otherwise be specifically provided for in 780 CMR 427.0, the Massachusetts State Building Code shall apply in its entirety.*

***Exception:** Chapter 34 shall not apply.*

***427.1.4** Mixed use occupancy: A limited group residence shall not be housed in a building used* *for any occupancy other than a limited group residence.*

> ***Exception:*** *Dwelling unit(s) meeting the requirements of 780 CMR 427.0 may be incorporated within a building in residential use provided unit separation walls and floor-ceiling assemblies shall serve to completely separate the limited group residence and provided that one of the limited group residence exitways is separate from the other uses.*

427.1.5 ***Plans and specifications:*** *Plans shall be filed with the building official having jurisdiction in accordance with 780 CMR 110.0 for any building to be constructed as, or altered for use as, a limited group residence under 780 CMR 427.0.*

427.1.6 Temporary certificate of occupancy: Upon satisfactory compliance with the code sections pertaining to building requirements, the building official shall issue a temporary certificate of occupancy in accordance with 780 CMR 120.3 for a period not to exceed 90 days. This temporary certificate of occupancy specifically prohibits residents as defined in 780 CMR 427.1.2 from inhabiting the building overnight until the building official issues the certificate of occupancy under 780 CMR 427.1.8.

427.1.7 Rules and regulations of the licensing or operating agency pertaining to and including, but not limited to, smoking regulations, staffing ratios, and resident classifications shall be provided to the building official by the licensing or operating agency prior to the issuance of a certificate of occupancy.

427.1.8 ***Certificate of occupancy:*** *Certificates of occupancy shall only be issued when a license, if appropriate, and an affidavit from the Department of Mental Health or the Office for Children, Commonwealth of Massachusetts, have been accepted by the building official attesting to the satisfactory compliance with the applicable rules and regulations referenced in 780 CMR 427.1.7.*

427.1.9 ***Certificate of inspection:*** *Certificates of inspection shall be issued by the building official in accordance with 780 CMR 106.0 and Table 106.*

427.1.10 Failure to comply: The building official immediately upon being informed by written report or otherwise that a building or structure or anything attached thereto or connected therewith is being occupied in violation of 780 CMR may revoke or suspend any permit, license, certificate or other permission regulated by 780 CMR and granted by him, and no such building or structure shall be continued to be operated after such revocation or suspension. Such revocation or suspension shall not preclude the building official from instituting appropriate action in accordance with 780 CMR 118.0.

427.2 New structures: All new structures shall be constructed, equipped, and maintained to the requirements of the One- and Two-Family Dwelling Code and 780 CMR 427.0, shall be limited to two stories in height, and shall have dwelling unit(s) limited to one story in height with direct access to grade without steps or changes in elevation other than ramps in accordance with 780 CMR 11. Corridors shall be of one hour fire resistive construction.

> *427.2.1 Other requirements: New structures shall also satisfy the general requirements contained in 780 CMR 427.1 and 427.3.*

427.3 Existing structures: Existing structures of any construction up to three stories or 40 feet in height may be converted and used for limited group residence occupancies. All residents classified as impaired as defined in 780 CMR 427.1.2 are restricted to those stories having direct access to grade without steps or changes in elevation other than ramps in accordance with 780 CMR 11.

> *427.3.1 Third-story utilization: The third story of buildings permitted by 780 CMR 427.3 may be only occupied by staff. Other use of the third story is restricted to heating, ventilation units and ordinary storage. All doors leading to non-resident areas shall be maintained locked.*
>
> *427.3.2 Vertical openings: Openings to such spaces as laundry chutes, dumb-waiters, heating plenums or combustible concealed spaces shall be permanently blocked with one hour fireresistance-rated construction, in accordance with the provisions of 780 CMR 7, unless such installation is in compliance with the pertinent provisions of other sections of 780 CMR.*
>
> > *427.3.2.1 Firestopping and draftstopping: Firestopping and draftstopping shall be provided in accordance with 780 CMR 720.0 and the One- and Two-Family Dwelling Code or as approved by the building official.*
>
> *427.3.3* ***Exitway Details:***
>
> > *427.3.3.1 Corridor width: The minimum clear width of an exitway access corridor shall be three feet.*
> >
> > > *Exception: In new structures the minimum clear width shall be four feet.*
> >
> > *427.3.3.2 Dead ends: In no case shall dead end corridors exceed 30 feet. Existing dead end corridors, wherever possible, shall be altered so that exitways shall be accessible in at least two different directions from all points in corridors.*

*427.3.3.3 **Corridor walls:** Corridor walls that separate use areas from exitway access corridors shall be of construction that will resist the passage of smoke.*

__Exception:__ Existing openings to congregate living areas, other than kitchens, shall be allowed to remain open.

427.3.3.4 Sleeping room doors: All sleeping room doors shall be of construction that will resist the passage of smoke. All doors shall be equipped with approved positive latching hardware and approved self-closing devices.

Exceptions:

1. Sleeping room doors may be equipped with approved hold-open smoke activated devices in accordance with 780 CMR 1017.0.

2. Hollow core doors shall not be permitted.

427.3.3.5 Means of Egress: All habitable floors shall be provided with at least two means of egress, located as remote as practicable from one another. Exitways shall be located to provide a safe path of travel to a public way without traversing any corridor or space exposed to an unprotected open stairway.

Exceptions:

1. Open stairs may be used as one of the required means of egress when permitted by 780 CMR 427.3.3.6, Exception 3. However, in no case may both required means of egress traverse the unprotected open space.

2. Access to one of the required exitways on sleeping room floors may be through adjoining rooms.

427.3.3.6 Interior exitway stairs: Every story shall be provide with at least one enclosed interior stairway which discharge directly to grade or through a grade passageway to a public way. The enclosed interior stairway(s) shall be of construction having a minimum fireresistance rating of one hour, properly firestopped. Spaces below the stairway(s) shall be enclosed to maintain the integrity of the one hour fireresistive construction of the stairway enclosure. Stairway(s) openings shall be protected by at least Class "B" label one hour fire door assemblies.

New stair construction shall comply with 780 CMR 1014.0. Existing stairs shall comply with the One- and Two-Family Dwelling Code or as approved by the building official.

Exceptions:

1. Secondary stairs not considered an exitway component may have door openings protected by a minimum 1⅜ inch solid bonded wood core doors or equivalent; however, such doors shall be equipped with approved automatic positive latching hardware and approved self-closing devices.

2. Basement/cellar: Stairway(s) shall be separated from the first floor by a 20 minute fire rated, self-closing door or equivalent.

3. One stairway may be allowed to remain unenclosed to preserve functional and aesthetic requirements.

*427.3.3.7 **Door widths:** No single egress door in a doorway shall be less than 28 inches wide.*

Exceptions:

1. Exitway door leaves shall not be less than 34 inches wide.

2. Door leaves to resident bedrooms occupied by residents who are classified as "Impaired" shall not be less than 34 inches wide.

*427.3.3.8 **Basement/cellar:** Basements/cellars shall be provided with at least two acceptable exitways, one of which shall discharge directly to the outside of the building.*

__Exception:__ Basement/Cellar areas with only one existing entrance from the outside only, and used solely as a mechanical space shall be permitted to maintain only one doorway which shall be maintained locked as an entrance/exitway.

427.3.3.9 Emergency escape: All sleeping rooms shall have at least one openable window or exterior door to permit smoke control, emergency escape, or rescue. A required door or window must be openable from the inside without the use of separate tools, and shall comply with 780 CMR 1010.4.

427.3.3.10 Means of egress lighting: Means of egress lighting systems shall be provided in accordance with 780 CMR 1024.0.

*427.3.3.11 **Locks:** Locks installed in resident sleeping room doors shall be so arranged that they can be locked from the corridor side. All such locks shall be arranged to permit exit from the room by a simple operation without the use of a key. Double cylinder dead bolts requiring key operation on both sides are prohibited throughout this occupancy.*

427.3.4 Interior finish: The flame spread of interior finish shall be limited to Class II in exitways or exit access corridors. Rooms shall be permitted to have interior finish of a Class III flame spread. Floor coverings shall conform to the requirements of 780 CMR 805.0 except that carpet type floor coverings shall possess a critical radiant flux of 0.22 w/cm^2 or greater.

427.3.5 Fire suppression systems: Automatic fire suppression systems shall be provided and *installed in accordance with NFiPA Standard No. 13D.*

Additions:

1. Exceptions listed in NFiPA Standard No. 13D applicable to dwellings shall not apply.

2. A water flow detector, connected to the fire alarm system, shall be provided.

3. NFiPA Standard No. 13D, Sections 4 through 6; Exception 1 shall not apply.

4. The control valve(s) shall be secured in the open position.

427.3.6 Fire alarm system: A manual fire alarm system shall be provided and installed in accordance with 780 CMR 917.0 and specifically NFiPA Standard No. 72 as listed in Appendix A.

427.3.7 Automatic protection alarm system: Approved smoke detectors shall be installed in accordance with 780 CMR 918.0 and specifically NFiPA Standard No. 72 as listed in Appendix A in the following locations:

1. exitway access corridors not more than 30 feet on center;

2. congregate living areas other than kitchens;

3. at least one detector in all basement/cellar areas; and

4. all sleeping rooms.

Exception: Smoke detectors used in combination with automatic closing devices may be substituted in each area aforementioned for the protection herein required.

427.3.8 Supervision: All automatic and manual fire alarm systems shall be supervised in accordance with 780 CMR 923.1 or 923.2

427.3.9 Heating devices: Portable comfort heating devices and solid fuel burning appliances are prohibited. Any heating device, other than a central heating plant, shall be so designed and installed that combustible material will not be ignited by it or its appurtenances. If fuel-fired, such heating devices shall be chimney or vent connected, shall take air for combustion directly from the outside, and shall be so designed and installed to provide for complete separation at the combustion system from the atmosphere of the occupied area. The heating system shall have safety devices to immediately stop the flow of fuel and shut down the equipment in case of either excessive temperature or ignition failure.

Exceptions:

1. Approved suspended unit heaters may be used in locations other than means of egress and sleeping areas, provided such heaters are located high enough to be out of the reach of persons using the area and provided they are equipped with the safety devices specified in 780 CMR 427.3.9.

2. Fireplaces which comply with 780 CMR 2114.0 may be used only in areas other than resident sleeping rooms. The fireplaces shall be equipped with a heat tempered glass fireplace enclosure guaranteed against breakage up to a temperature of 650 °F. A lock on the enclosure shall be required.

427.3.10 Fire drills: The licensing or operating agency shall require that fire drills be held with sufficient frequency so as to familiarize all residents and staff personnel with emergency procedures. Drills shall be held at unexpected times under varying conditions to simulate the unpredictable conditions which may occur in case of fire, including blocking of any point of any means or egress.

427.3.10.1 Log: A log shall be kept of all fire drills and shall be available for inspection and duplication by the building official, fire official, and other parties having jurisdiction.

427.3.10.2 The resident manager shall record in said log the names of any authorized inspectors who may have been present and the names or identifying numbers of the residents who participated.

780 CMR 428.0 DETOXIFICATION FACILITIES

428.1 General: A detoxification facility is a facility licensed or operated by the Department of Public Health, Division of Alcoholism in accordance with the Rules and Regulations for Detoxification Facilities issued by the Department of Public Health, Division of Alcoholism, Commonwealth of Massachusetts, and shall be used to treat individuals acceptable to the program in accordance with those Rules and Regulations.

428.2 Scope: Detoxification facilities shall be subject to the requirements of 780 CMR 428.0 for new and existing buildings which are to be used or operated as licensed facilities. 780 CMR 428.0 shall establish the requirements applicable to such facilities. Where specific reference is made to other sections of 780 CMR, to reference standards or other regulations, those requirements cited shall apply. Where no reference is specifically made, 780 CMR, including 780 CMR 34, shall apply.

428.3 Classification of Residents: All residents enrolled in the detoxification program shall be identified according to one of the following classifications when evaluated by the facility personnel in accordance with the Rules and Regulations for Detoxification Facilities of the Division of Alcoholism of the Department of Public Health:

1. Impaired
2. Partially Impaired
3. Unimpaired

428.4 Definitions: The following terms shall have the meaning indicated for the purpose of 780 CMR 428.0 only:

Impaired: Anyone who will require assistance to egress the building

Partially Impaired: Anyone who may require assistance to egress the building.

Unimpaired: Anyone who appears able to egress the building without assistance.

428.5 Use group classification: Detoxification facilities licensed and approved in accordance with these provisions shall be classified in the R-1 use group.

428.6 Mixed use occupancy: A portion of a building may be used for a detoxification facility provided that it is completely separated from the rest of the building by both horizontal and vertical fire separation assemblies of at least one hour fireresistance rating.

> **Exception:** Detoxification facilities shall not be located in buildings in which any of the following use groups are located: A-2, F, H, or S-1.

428.7 Submission of plans: Plans shall be filed with the building official in accordance with 780 CMR 110.0 for any building to be constructed as, or altered for use as, a detoxification facility under 780 CMR 428.0. The plans shall also identify those rooms which comply with 780 CMR 428.0 for use by the impaired.

428.8 Inspection and certification: The building official shall inspect and certify detoxification facilities once every two years. Fees shall be applied in accordance with Table 106 for the R-1 Use Group.

428.9 Resident location limitations: In buildings used as detoxification facilities in accordance with 780 CMR 428.0, resident locations shall be limited according to the use and type of construction as provided in Table 428.9. All heights are in stories above grade. All buildings used as detoxification facilities in accordance with 780 CMR 428.0 shall be accessible to the Fire Department wherever escape windows are required.

Table 428.9
RESIDENT SLEEPING ROOM LOCATION LIMITATION FOR DIFFERENT TYPES OF CONSTRUCTION

Classification of Resident	Type of Building Construction									
	1A	1B	2A	2B	2C	3A	3B	4	5A	5B
Impaired	No limit	8 st.	4 st.	2 st.	1 st.	2 st.	1 st.	2 st.	1 st.	1 st.
Partially impaired	No limit	No limit	8 st.	3 st.	1 st.	3 st.	2 st.	3 st.	2 st.	1 st.
Unimpaired	No limit	No limit	9 st.	4 st.	3 st.	4 st.	3 st.	4 st.	3 st.	2 st.

Note: * Impaired sleeping rooms in 5B construction require either full building sprinklering or one hour fire rated separation for floor and ceiling of sleeping room walls.

428.9.1 Sprinklered buildings:: Buildings which are completely sprinklered may have resident locations one story higher than allowed in Table 428.9.

428.9.2 Sleeping room limitations: Sleeping facilities in building licensed for use as detoxification facilities shall not be located below the first story.

428.10 Egress: At least two exitways located as remote as practicable from each other shall be provided from each floor of the building.

428.10.1 Every room used for sleeping for the impaired and partially impaired shall have an exitway access door leading directly to an exitway access corridor:

Exceptions:
1. Rooms having a means of egress doorway leading directly to the exterior of the building at grade.
2. Rooms having a means of egress doorway leading directly to the exterior of the building above grade and connected directly to grade by means of an exterior stairway in accordance with 780 CMR 1014.0.

428.10.2 All other sleeping rooms: All other sleeping rooms shall comply with the requirements of 780 CMR 10 in accordance with the provisions for the R-1 use group.

428.10.3 Corridors shall provide at least 36 inches minimum nominal width.

428.10.4 All means of egress doorways shall be 32 inches minimum nominal width.

> **Exception:** Egress doorways from impaired sleeping rooms shall 36 inches minimum nominal width.

428.10.5 Every required exitway access corridor shall have a one hour fire-resistance rating and shall provide access to at least two approve exitways without passing through any *intervening rooms or spaces other than corridors and lobbies.*

> *Exception: In buildings with a complete sprinkler system, exitway access corridors not required for the impaired or partially impaired may be separated from other use areas by non-fire rated partitions*

428.10.6 Stairways: Where not otherwise specified in 780 CMR 428.2, a stairway required as a means of egress shall be subject to these requirements:

> *428.10.6.1 Stairways required to provide egress for the impaired shall be at least 36 inches minimum nominal width. The total capacity of the stairways shall be adequate for the occupancy load served.*
>
> *428.10.6.2 Stairway enclosures shall have a fireresistance rating of one hour for buildings not exceeding three stories in height, and two hours for buildings exceeding three stories in height.*
>
> *428.10.6.3 Doors to the required exitway stairways shall be fire doors complying with 780 CMR 716.0 . Labeled fire doors shall have a maximum transmitted temperature end point of not more than 450 °F (232 °C) above ambient at the end of 30 minutes of standard fire test exposure.*

428.11 Interior finish: Interior finish requirements shall comply with Table 428.11.

> *Exceptions:*
>
> *1. In buildings which are completely sprinklered, the interior finish requirements may be reduced one level except in sleeping rooms for the impaired.*
>
> *2. The interior finish classifications in existing buildings may be improved one level by the use of fire retardant coatings which have been approved when tested in accordance with ASTM E-84.*

TABLE 428.11
INTERIOR FINISH REQUIREMENTS

Location	*Walls*	*Floor*	*Ceiling*
Sleeping rooms, Impaired	*II*	*II*[2]	*II*
Corridors, Impaired	*I*	*I*[1]	*I*
Sleeping rooms, Partially impaired	*I*	*I*[1]	*I*
Corridors, Partially impaired	*I*	*I*[1]	*I*
All other exitway access corridors	*II*	*II*[2]	*II*
Stairways	*I*	*I*[1]	*I*

Note 1: Carpet type floor coverings shall withstand a test exposure of 0.45 watts per square centimeter when tested in accordance with 780 CMR 805.0.

Note 2: Carpet type floor coverings shall withstand a test exposure of 0.22 watts per square centimeter when tested in accordance with 780 CMR 805.0.

428.12 Fire alarm systems: Manual and automatic fire alarm systems shall be provided in accordance with 780 CMR 917.0 and 918.0 as they apply to Use Group R-1.

> *Exceptions:*
>
> *1. In rooms for the impaired and partially impaired the heat detectors required by 780 CMR 918.0 shall be replaced with approved smoke detectors.*
>
> *2. All buildings or portions thereof regardless of the number of beds shall incorporate manual pull stations in conformance with 780 CMR 917.0.*
>
> *428.12.1 Supervision: All automatic and manual fire alarm systems shall be supervised in accordance with 780 CMR 923.1 or 923.2.*

428.13 Means of egress lighting: Means of egress lighting including an emergency lighting system shall be provided throughout the facility in accordance with 780 CMR 917.0.

428.14 Smoke enclosure doors: Smoke enclosure doors shall be tight-fitting with approved hardware.

428.15 Heating apparatus: The use of portable heaters, solid fuel burning room heaters and fireplaces shall be prohibited.

428.16 Sprinkler systems: Where a complete building sprinkler system is installed it shall comply with the provisions of NFiPA Standard No. 13, as listed in Appendix A.

> *428.16.1 All rooms used for sleeping for the impaired shall be sprinklered.*
>
> > *Exception: A partial system required for sleeping rooms housing impaired individuals may be provided with a sprinkler system serving no more than six sprinklers, which may be connected directly to a domestic water supply system having capacity sufficient to provide 0.15 gallons per minute per square foot of floor area throughout the entire area, An indicating shut-off valve shall be installed in an accessible location between the sprinklers and the connection the domestic water supply.*

780 CMR429.0 GROUP DWELLING UNITS

429.1 General: A Group Dwelling Unit is a dwelling unit licensed by or operated by the

Department of Mental Retardation or the Department of Mental Health as special residence for up to four persons who may or may not be capable of self preservation from fire or other related hazards. Note, however, 780 CMR 429.1, Exceptions 1 and 2. The provisions of 780 CMR 429.0 shall apply to both new and existing Group Dwelling Units.

Exception 1: 780 CMR 429.0 shall not apply to a group dwelling unit operated or licensed by the Department of Mental Retardation (DMR) pursuant to 115 CMR 7.00 and 8.00, upon the completion of a DMR safety assessment for each individual and an approved safety plan for each location where services and supports are provided. Such premise shall be treated as conventional R-4, R-3, R-2 and R-1 use as applicable.

Exception 2: Apartment programs as defined in 104 CMR 17.13(2)(c) in which residents therein are also capable of self preservation (unimpaired) shall be exempt from all requirements of 780 CMR 429.0. Such apartment programs shall be classified as R-1, R-2, R-3, or R-4, as applicable.

429.1.1 Classification of Use: Group Dwelling Units shall be classified as follows:

Use Group R-2 - The Group Dwelling Unit(s) is (are) one or more of three or more dwelling units contained in the building.
Use Group R-3 or R-4 - The Group Dwelling Unit(s) is (are) contained in a one or two family dwelling.

429.1.2 Classification of Residents: Persons other than staff of the facility who occupy or intend to occupy Group Dwelling Units shall be classified by the Licensing or Operating Agency in one of the following three categories according to their capabilities for self preservation:

Impaired: Any resident who is incapable of self preservation through physical, mental or developmental disability, so as to require physical assistance from the staff of the Group Dwelling Unit to exit the building or to reach an area of refuge within 2½ minutes.

Partially Impaired: Any resident who is capable with either supervision or instruction from the staff of the Group Dwelling Unit but without physical assistance, of exiting the building or reaching an area of refuge within 2½ minutes.

Unimpaired: Any resident who is capable of exiting the building or reaching an area of refuge within 2½ minutes without physical assistance, supervision or instruction.

429.1.3 Application of building code and reference: Except as may otherwise be specifically provided in 780 CMR 429.0, 780 CMR shall apply in its entirety.

Exception: 780 CMR 34 shall not apply. However, existing buildings may be used to house group dwelling units, provided that they comply with the applicable portions of 780 CMR 429.0, and have no outstanding violations of 780 CMR or the specialized codes.

429.1.4 Plans and specifications: Plans shall be filed with the building official having jurisdiction in accordance with 780 CMR 110.0 for any building to be constructed as, or altered for use as a Group Dwelling Unit under 780 CMR 429.0.

429.1.5 Temporary Certificate of Occupancy: Upon satisfactory compliance with the code sections pertaining to building requirements, the building official shall issue a temporary certificate of occupancy in accordance with 780 CMR 120.3 for a period not to exceed 90 days. This temporary certificate of occupancy specifically prohibits residents as defined in 780 CMR 429.1.2 from inhabiting the building overnight until the building official issues the certificate of occupancy under 780 CMR 429.1.8.

429.1.6 Corresponding Rules and Regulations: 115 CMR (the Department of Mental Retardation) or 104 CMR 17.13 (the Department of Mental Health) as listed in Appendix A, pertaining to and including, but not limited to, smoking regulations, staffing ratios, and resident classifications shall be provided upon request to the building official by the Licensing or Operating Agency prior to the issuance of a certificate of occupancy. Note, however, 780 CMR 429.1, Exceptions 1 and 2.

429.1.7 Certification of Residents: The Licensing Agency shall certify the classification of each resident prior to application for a Certificate of Occupancy and shall regularly re-examine and, where necessary, reclassify residents in accordance with Department of Mental Retardation or Department of Mental Health regulations as listed in Appendix A. Copies of the current certification of each resident shall be kept on file at the Group Dwelling Unit, and shall be made available to the building official upon request. Note, however, 780 CMR 429.1, Exceptions 1 and 2.

429.1.8 Certificate of Occupancy: Certificates of occupancy shall be issued only when a license and/or affidavit from the Department of Mental Retardation or the Department of Mental Health have been provided to the building official attesting to the satisfactory compliance with the *applicable rules and regulations referenced in 780 CMR 429.1.6, the capabilities for self preservation of all residents, and, if appropriate, the intent to license the facility. Upon compliance with all building requirements of 780 CMR 429.0 and receipt of the Licensing Agency's affidavit, the building official shall issue a certificate of occupancy within 72 hours. In addition to the contents specified in 780 CMR 120.4, the certificate shall indicate the category of Group Dwelling Unit for which the building has been constructed or altered, as defined in 780 CMR 429.2. Note, however, 780 CMR 429.1, Exceptions 1 and 2.*

***429.2 Category of Unit/Compliance Options:** New and existing building containing Group Dwelling Units shall be required to satisfy at least one compliance option presented for the appropriate category of residency as defined in 780 CMR 429.2:*

***Category A Group Dwelling Unit** - May contain any or all of the resident classifications.*

***Category B Group Dwelling Unit** - May contain only partially impaired or unimpaired residents.*

Category C Group Dwelling Unit - Shall contain only unimpaired residents.

***429.2.1** Category A Unit Compliance Options: Buildings housing Group Dwelling Units classed as "Category A" shall comply with any one of the following compliance options:*

1. *The entire building shall be equipped with a fire suppression system; or*
2. *The building shall be of a protected construction type (Type 1, 2A, 2B, 3A, 4 or 5A). All interior stairways shall be enclosed to comply with the requirements of 780 CMR for interior exitway stairways and shall discharge directly to the exterior of the building or into a code complying grade passageway or lobby. The building shall also be equipped with fire alarms complying with 780 CMR 9 for the appropriate use group classification; or*
3. *The Building shall comply with the provisions of 780 CMR 427.0; or*
4. *If of unprotected construction (Types 2C, 3B or 5B), the building shall be equipped with fire alarms complying with 780 CMR 9 for the appropriate use group classification. No Group Dwelling Unit(s) shall utilize portions of the building above the second story. All stories in the building shall be equipped with two approved, independent exitways (even if the building is classified in Use Group R-3). Interior exitway stairways shall be enclosed to comply with the requirements of 780 CMR for interior exitway stairways and shall discharge directly to the exterior of the building or into a code complying grade passageway or lobby; or*
5. *In those buildings of unprotected constructed (Types 2C, 3B or 5B) where enclosure of interior exitway stairways is impractical due to physical limitations of configuration of the building (e.g. split entry type stairways), the stairway(s) may be permitted to remain unenclosed, provided that all sleeping rooms are segregated from the open stairway by a minimum of one hour fire resistive construction and the exitways are arranged so that a second means of egress is available from each sleeping area which does not pass through the open stairway area. The building shall also be equipped with fire alarms complying with 780 CMR 9 for the appropriate use group classification. No Group Dwelling Unit shall utilize portions of the building above the second story. All stories in the building shall be equipped with two approved, independent exitways (even if the building is classified in Use Group R-3).*

***429.2.1.1** Limitation on location of **impaired** residents: All sleeping rooms of impaired residents shall either be located on the first story or on a story containing a horizontal exit complying with 780 CMR 1019.0.*

***429.2.2** Category B Unit Compliance Options: Buildings housing Group Dwelling Units classified as "Category B" shall comply with any one of the following compliance options:*

1. *Any Category A compliance option; or*
2. *All stories in the building shall be provided with two approved, independent exitways (even if the building is classified in Use Group R-3). All interior stairways shall be enclosed to comply with the requirements of 780 CMR for interior exitway stairways and shall discharge directly to the exterior of the building or into a code complying grade passageway or lobby. The building also shall be equipped with fire alarms complying with 780 CMR 9 for the appropriate use group classification.*

***429.2.3** Category C Unit Compliance Options: Buildings housing Group Dwelling Units classified as "Category C" shall comply with any one of the following compliance options:*

1. *Any Category A compliance option; or*
2. *Any Category B compliance option; or*
3. *The building shall comply with the provisions of 780 CMR 423.0.*

429.3 Special Fire Safety Items:

*429.3.1 **Hazardous Contents:** No contents which represent a fire hazard greater than that which could be expected of ordinary household* *furnishings shall be permitted within a Group Dwelling Unit.*

429.3.2 Interior Finish: Interior finish in exitways and exitway access corridors shall be a minimum of Class II, unless the building is equipped with a fire suppression system. Approved fire retardant paints may be used to improve the interior finish classification of existing construction to satisfy this requirement.

429.3.3 Locks: Double cylinder deadbolt locks which require a key operation on the side from which egress is to be made are not permitted in Group Dwelling Units. Locks of any type are prohibited on sleeping room doors of impaired or partially impaired residents or on any door which provides access to an exitway.

429.4 Special inspection/fire drill: Prior to occupancy of the group dwelling unit the Licensing Agency shall conduct a fire drill to test the capability of residents to exit according to their residency classification. At least once every 90 days, the Operating Agency shall also conduct a fire drill to test the capability of residents to exit according to their residency classification. Drills shall be held at unexpected times under varying conditions to simulate the unpredictable nature of fire emergencies. The building official may, at his option, participate in or witness the fire drill, or may accept an affidavit from the Operating Agency attesting to the performance of each resident or prospective resident. The affidavit shall also specify the date, time and conditions of the drill, and shall list all participants and witnesses.

429.4.1 Conduct of the Fire Drill: During the conduct of the drill, one exit shall be blocked to simulate a hazardous condition and the alarm system shall be activated. Successful performance for each resident shall be defined as his/her ability to exit the building, or where horizontal exits are provided to reach an area of refuge within 2½ minutes of the activation of the fire alarm system. Only those staff members who are normally on duty shall be allowed to assist residents, and the only assistance permitted shall be that which is provided by the staff of the Group Dwelling Unit consistent with the classification of each individual resident.

CHAPTER 5

GENERAL BUILDING LIMITATIONS

780 CMR 501.0 GENERAL

501.1 Scope: The provisions of 780 CMR 5 control the *height* and *area* of all structures hereafter erected, and *additions* to existing structures based on the type of construction, use group, frontage on open space providing exposure protection and access to structures for fire-fighting purposes, and the presence of an *automatic sprinkler system*.

780 CMR 502.0 DEFINITIONS

502.1 General: The following words and terms shall, for the purposes of 780 CMR 5 and as used elsewhere in 780 CMR, have the meanings shown herein.

Area, building: The *area* included within surrounding exterior walls (or exterior walls and fire walls) exclusive of vent *shafts* and *courts*. Areas of the building not provided with surrounding walls shall be included in the building area if such areas are included within the horizontal projection of the roof or floor above.

Basement: That portion of a building which is partly or completely below grade (see *"Story above grade"*).

Grade plane: A reference plane representing the average of finished ground level adjoining the building at all exterior walls. Where the finished ground level slopes away from the exterior walls, the reference plane shall be established by the lowest points within the area between the building and the *lot line* or, where the *lot line* is more than six feet (1829 mm) from the building, between the building and a point six feet (1829 mm) from the building.

Height

Building: The vertical distance from *grade plane* to the average height of the highest roof surface.

Story: The vertical distance from top to top of two successive tiers of beams or finished floor surfaces; and, for the topmost story, from the top of the *floor finish* to the top of the ceiling joists or, where there is not a ceiling, to the top of the roof rafters.

Mezzanine: An intermediate level or levels between the floor and ceiling of any story with an aggregate floor area of not more than ⅓ of the area of the room in which the level or levels are located (see 780 CMR 505.0).

Story: That portion of a building included between the upper surface of a floor and the upper surface of the floor or roof next above (also see *"Mezzanine"*).

Story above grade: Any story having its finished floor surface entirely above grade except that a *basement* shall be considered as a story above grade where the finished surface of the floor above the *basement* is:

1. More than six feet (1829 mm) above *grade plane*;
2. More than six feet (1829 mm) above the finished ground level for more than 50% of the total building perimeter; or
3. More than 12 feet (3658 mm) above the finished ground level at any point.

780 CMR 503.0 GENERAL HEIGHT AND AREA LIMITATIONS

503.1 General: The *heights* and *areas* of all buildings and structures between exterior walls or between exterior walls and *fire walls*, shall be governed by the type of construction and the use group classification as defined in 780 CMR 3 and 6 and shall not exceed the limitations fixed in Table 503, except as specifically modified by 780 CMR 5 and the following sections:

Section	Subject
402.7	Covered mall buildings
403.3.3.1	High-rise buildings
414.2	Airport traffic control towers
416.3	HPM facilities
418.3.1.1	Grain elevators
426.0	***Bulk Merchandizing Retail Buildings***
3103.3.5	Membrane structures

503.1.1 Special industrial occupancies: All buildings and structures designed to house low-hazard industrial processes that require large *areas* and unusual *heights* to accommodate craneways or special machinery and equipment, including, among others, rolling mills, structural metal fabrication shops and foundries, or the production and distribution of electric, gas or steam power, shall be exempt from the *height* and *area* limitations of Table 503.

503.1.2 Open parking structures: Open parking structures shall conform to the *height* and *area* limitations specified in 780 CMR 406.4.

503.1.3 Buildings on same lot: Two or more buildings on the same *lot* shall be regulated as separate buildings or shall be considered as portions of one building if the height of each building and the aggregate area of all buildings are within the limitations of Table 503 as modified by 780 CMR 504.0 and 506.0. The provisions of 780 CMR applicable to the aggregate building shall be applicable to each building.

Table 503
HEIGHT AND AREA LIMITATIONS OF BUILDINGS

Height limitations of buildings (shown in upper figure as stories and feet above grade plane)[n], and area limitations of one- or two-story buildings facing on one street or public space not less than 30 feet wide (shown in lower figure as area in square feet per floor[n]). See Note a.

Table notes appear immediately following table.
N.P. = Not Permitted; N.L. = Not Limited

USE GROUPS	Type of Construction									
	Noncombustible					Noncombustible/ Combustible			Combustible	
	Type 1		Type 2			Type 3		Type 4	Type 5	
	Protected Note b		Protected		Unprotected	Protected	Unprotected	Heavy timber	Protected	Unprotected
Note a	1A	1B	2A	2B	2C	3A	3B	4	5A	5B
A-1 Assembly; theaters	N.L.	N.L.	5 St. 65' 19,950	3 St. 40' 13,125	2 St. 30' 8,400	3 St. 40' 11,550	2 St. 30' 8,400	3 St. 40' 12,600	1 St. 20' 8,925	1 St. 20' 4,200
A-2 Assembly; night clubs and similar uses	N.L.	N.L. 7,200	3 St. 40' 5,700	2 St. 30' 3,750	1 St. 20' 2,400	2 St. 30' 3,300	1 St. 20' 2,400	2 St. 30' 3,600	1 St. 20' 2,550	1 St. 20' 1,200
A-3 Assembly; lecture halls, recreation centers, terminals, restaurants other than night clubs	N.L.	N.L.	5 St. 65' 19,950	3 St. 40' 13,125	2 St. 30' 8.400	3 St. 40' 11.550	2 St. 30' 8,400	3 St. 40' 12,600	1 St. 20' 8,925	1 St. 20' 4,200
A-4 Assembly; churches Note c	N.L.	N.L.	5 St. 65' 34,200	3 St. 40' 22,500	2 St. 30' 14,400	3 St. 40' 19,800	2 St. 30' 14,400	3 St. 40' 21,600	1 St. 20' 15,300	1 St. 20' 7,200
B Business	N.L.	N.L.	7 St. 85' 34,200	5 St. 65' 22,500	3 St. 40' 14,400	4 St. 50' 19,800	3 St. 40' 14,400	5 St. 65' 21,600	3 St. 40' 15,300	2 St. 30' 7,200
E Educational Note c	N.L.	N.L.	5 St. 65' 34,200	3 St. 40' 22,500	2 St. 30' 14,400	3 St. 40' 19,800	2 St. 30' 14,400	3 St. 40' 21,600	1 St. 20' 15,300 Note d	1 St. 20' 7,200 Note d
F-1 Factory and industrial Moderate	N.L.	N.L.	6 St. 75' 22,800	4 St. 50' 15,000	2 St. 30' 9,600	3 St. 40' 13,200	2 St. 30' 9,600	4 St. 50' 14,400	2 St. 30' 10,200	1 St. 20' 4,800
F-2 Factory and Industrial low Note h	N.L.	N.L.	7 St. 85' 34,200	5 St. 65' 22,500	3 St. 40' 14,400	4 St. 50' 19,800	3 St. 40' 14,400	5 St. 65' 21,600	3 St. 40' 15,300	2 St. 30' 7.200
H-1 High hazard, detonaton hazards Notes e, i, k, l	1 St,20' 16.800	1 St. 20' 14,400	1 St. 20' 11,400	1 St. 20' 7,500	1 St. 20' 4,800	1 St. 20' 6,600	1 St. 20' 4,800	1 St. 20' 7,200	1 St. 20' 5,100	N.P
H-2 High Hazard deflagration hazards Note e,i,j,l	5 St. 65' 16,800	3 St. 40' 14,400	3 St. 40' 11,400	2 St. 30' 7,500	1 St. 20' 4,800	2 St. 30' 6,600	1 St. 20' 4,800	2 St. 30' 7,200	1 St. 20' 5,100	N.P.
H-3 High Hazard physical hazards Note e,l	7 St. 85' 33,600	7 St. 85' 28,800	6 St. 75' 22,800	4 St. 50' 15,000	2 St. 30' 9,600	3 St. 40' 13,200	2 St. 30' 9,600	4 St. 50' 14,400	2 St. 30' 10,200	1 St. 20' 4,800
H-4 High Hazard health hazards Note e,l	7 St. 85' N.L.	7 St. 85' N.L.	7 St. 85' 34,200	5 St. 65' 22,500	3 St. 40' 14,400	4 St. 50' 19,800	3 St. 40' 14,400	5 St. 65' 21,600	3 St. 40' 15,300	2 St. 30' 7,200
I-1 Institutional, residential care	N.L.	N.L.	9 St.100' 19,950	4 St. 50' 13,125	3 St. 40' 8,200	4 St. 50' 11.550	3 St. 40' 8,400	4 St.50' 12,600	3 St. 40' 8,925	2 St. 35' 4,200
I-2 Institutional, incapacitated Note m	N.L.	N.L.	4 St. 50' 17,100	2 St. 30' 11,250	1 St. 20' 7,200	1 St. 20' 9,900	N.P.	1 St. 20' 10,800	1 St. 20' 7,650	N.P.
I-3 Institutional, restrained	N.L.	N.L.	4 St. 50' 14,250	2 St. 30' 9,375	1 St. 20' 6,000	2 St. 30' 8,250	1 St. 20' 6,000	2 St. 30' 9,000	1 St. 20' 6,375	N.P.
M Mercantile	N.L.	N.L.	6 St. 75' 22,800	4 St. 50' 15,000	2 St. 30' 9,600	3 St. 40' 13,200	2 St. 30' 9,600	4 St. 50' 14,400	2 St. 30' 10,200	1 St. 20' 4,800
R-1 Residential, hotels	N.L.	N.L.	9 St.100' 22,800	4 St. 50' 15,000	3 St. 40' 9,600	4 St. 50' 13,200	3 St. 40' 9,600	4 St. 50' 14,400	3 St. 40' 10,200	2 St. 35' 4,800
R-2 Residential, multi-family	N.L.	N.L.	9 St.100' 22,800	4 St. 50' 15,000 Note f	3 St. 40' 9,600	4 St. 50' 13,200 Note f	3 St. 40' 9,600	4 St. 50' 14,400	3 St. 40' 10,200	2 St. 35' 4,800
R-3 Residential, multiple single family	N.L.	N.L.	4 St. 50' 22,800	4 St. 50' 15,000	3 St. 40' 9,600	4 St. 50' 13,200	3 St. 40' 9,600	4 St. 50' 14,400	3 St. 40' 10,200	2 St. 35' 4,800
S-1 Storage, moderate	N.L.	N.L.	5 St. 65' 19,950	4 St. 50' 13,125	2 St. 30' 8,400	3 St. 40' 11,550	2 St. 30' 8,400	4 St. 50' 12,600	2 St. 30' 8,925	1 St. 20' 4,200
S-2 Storage, low Note g	N.L.	N.L.	7 St. 85' 34,200	5 St. 65' 22,500	3 St. 40' 14,400	4 St. 50' 19,800	3 St. 40' 14,400	5 St. 65' 21,600	3 St. 40' 15,300	2 St. 30' 7,200
U Utility, miscellaneous	N.L.	N.L.								

Notes applicable to Table 503:

Note a. See the following sections for general exceptions to Table 503:

780 CMR 504.2 Allowable height increase due to automatic sprinkler system installation.

780 CMR 506.2 Allowable area increase due to street frontage.
780 CMR 506.3 Allowable area increase due to automatic fire suppression system installation.
780 CMR 506.4 Allowable area reduction for multi-story buildings.
780 CMR 507.0 Unlimited area one-story buildings.

Note b. Buildings of Type 1 construction permitted to be of unlimited tabular heights and areas are not subject to special requirements that allow increased heights and areas for other types of construction (see 780 CMR 503.1.4).

Note c. For height exceptions for auditoriums in occupancies in Use Groups A-4 and E, see 780 CMR 504.3.

Note d. For height exceptions for day care centers in buildings of Type 5 construction, see 780 CMR 504.4.

Note e. For exceptions to height and area limitations of buildings for Use Group H, see 780 CMR 4 governing the specific use groups.

Note f. For exceptions to height of buildings for Use Group R-2 of Types 2B and 3A construction, see 780 CMR 504.6 and 504.7.

Note g. For height and area exceptions for open parking structures, see 780 CMR 406.0.

Note h. For exceptions to height and area limitations for special industrial occupancies, see 780 CMR 503.1.1.

Note i. Occupancies in Use Groups H-1 and H-2 shall not be permitted below grade.

Note j. Rooms and areas of Use group H-2 containing pyrophoric materials shall not be permitted in buildings of Type 3, 4, or 5 construction.

Note k. Occupancies in Use Group H-1 are required to be detached one-story buildings (see 780 CMR 707.1.1).

Note l. For exceptions to height for buildings with occupancies in Use Group H, see 780 CMR 504.5

Note m. ***Hospitals, other than college or school infirmaries, shall be constructed of Type 1-B or higher construction.***

Note n. 1 foot = 304.8 mm; 1 square foot = 0.093 m^2

503.1.4 Type 1 construction: Buildings of Type 1 construction which are permitted to be of unlimited tabular *heights* and *areas* by Table 503, are not subject to the special requirements that allow increased *heights* and *areas* for other types of construction.

503.2 Area limitations: The *area* limitations specified in Table 503 shall apply to the maximum horizontally projected area of all buildings fronting on a street or a public space not less than 30 feet (9144 mm) in width with access from a public street.

503.3 Height limitations: The *height* in feet and the number of *stories above grade* specified in Table 503 shall apply to all buildings and to all separate parts of a building that are enclosed within *fire walls* complying with the provisions of 780 CMR 7. A *basement* shall be considered as a *story above grade* where the finished surface of the floor above the *basement* is more than six feet (1829 mm) above *grade plane*; or more than six feet (1829 mm) above the finished ground level for more than 50% of the total building perimeter; or more than 12 feet (3658 mm) above the finished ground level at any point.

780 CMR 504.0 HEIGHT MODIFICATIONS

504.1 General: The provisions of 780 CMR 504.0 shall modify the *height* limitations of Table 503 as herein specified.

504.2 Automatic sprinkler systems: Where a building is equipped throughout with an automatic sprinkler system in accordance with 780 CMR 906.2.1, the building height limitation specified in Table 503 shall be increased one story and 20 feet (6096 mm). This increase shall not apply to buildings of Types 2C, 3A, 4 and 5A construction with an occupancy in Use Group I-2, or to buildings with an occupancy in Use Group H-1, H-2 or H-3. The building height limitations for buildings with an occupancy in Use Group R specified in Table 503 shall be increased one story and 20 feet (6096mm) where the building is equipped throughout with an automatic sprinkler system installed in accordance with 780 CMR 906.2.2 and the system is supervised in accordance with 780 CMR 923.1, method 1, 2 or 3, but not to exceed a height of four stories or 60 feet (18288 mm).

504.3 Auditoriums: The maximum *height* of auditoriums in Use Groups A-4 and E shall be 65 feet (19812 mm) in buildings of Type 2B, 3A, 4 or 5A construction and 45 feet (13716 mm) in buildings of Type 2C, 3B or 5B construction.

504.4 Day care centers: The *height* limitations of Table 503 for day care centers classified as Use Group E, in buildings of Type 5 construction, shall be increased one story and 20 feet (6096 mm) provided that the total occupant load is less than 50 persons.

504.5 High-hazard use groups: Buildings and structures with an occupancy in Use Group H that requires unusual *heights* necessary to accommodate special manufacturing processes and equipment shall be exempt from the tabular *height* limitations, in feet, of Table 503.

504.6 Type 3A construction: The *height* limitation for buildings of Type 3A construction with occupancies in Use Group R-2 shall be increased to six stories and 75 feet (22860 mm) where the first floor above the *basement* has a fireresistance rating of not less than three hours and the floor *area* is subdivided by two-hour fireresistance rated *fire walls* into *fire areas* of not more than 3,000 square feet (279 m²).

504.7 Type 2B construction: The *height* limitation for buildings of Type 2B construction with occupancies in Use Group R-2 shall be increased to nine stories and 100 feet (30480 mm) where the building is separated by not less than 50 feet (15240 mm) from any other building on the *lot* and from *interior lot lines*, the *exits* are segregated in a *fire area* enclosed by a two-hour fireresistance rated *fire wall* and the first floor construction has a fireresistance rating of not less than 1½ hours.

780 CMR 505.0 MEZZANINES

505.1 General: A *mezzanine* or mezzanines in compliance with 780 CMR 505.0 shall be considered a portion of the floor below. Such *mezzanines* shall not contribute to the *building area* as regulated by 780 CMR 503.2. Such *mezzanines* shall not contribute to the number of stories as regulated by 780 CMR 503.3. The area of the *mezzanine* shall be included in determining the *fire area*.

505.2 Area limitation: The aggregate area of a *mezzanine* or *mezzanines* within a room shall not exceed ⅓ of the area of that room. The enclosed portions of rooms shall not be included in a determination of the size of the room in which the *mezzanine* is located. In determining the allowable *mezzanine* area, the area of the *mezzanine* shall not be included in the area of the room.

Exception: The aggregate area of *mezzanines* in buildings and structures of Type 1 or 2 construction for special industrial occupancies in accordance with 780 CMR 503.1.1 shall not exceed ⅔ of the area of that room.

505.3 Egress: Each occupant of a *mezzanine* shall have access to at least two independent *means of egress* where such spaces require two *means of egress* in accordance with 780 CMR 1017.2. Where a *stairway* provides a means of *exit access* from a *mezzanine*, the maximum travel distance required by 780 CMR 1017.2 shall be measured to the bottom of the *stairway*.

505.4 Openness: A *mezzanine* shall be open and unobstructed to the room in which such *mezzanine* is located except for walls not more than 42 inches (1067 mm) high, columns and posts.

Exceptions

1. *Mezzanines* or portions thereof are not required to be open to the room in which the *mezzanines* are located, provided that the occupant load of the aggregate area of the enclosed space does not exceed ten.
2. A *mezzanine* having two or more *means of egress* is not required to be open to the room in which the *mezzanine* is located, if at least one of the *means of egress* provides direct access to an *exit* from the *mezzanine* level.

780 CMR 506.0 AREA MODIFICATIONS

506.1 General: The provisions of 780 CMR 506.0 shall modify the *area* limitations of Table 503 as herein specified.

506.2 Street frontage increase: Where a building or structure has more than 25% of the building perimeter fronting on a street or other unoccupied space, the *area* limitations specified in Table 503 shall be increased 2% for each 1% of such excess frontage. The unoccupied space shall be on the same *lot* or dedicated for public use, shall not be less than 30 feet (9144 mm) in width and shall have access from a street by a posted fire lane not less than 18 feet (5486 mm) in width.

506.3 Automatic sprinkler system: Where a building, other than those with an occupancy in Use Group H-1, H-2 or H-3, is equipped throughout with an *automatic sprinkler system* installed in accordance with 780 CMR 906.2.1, the *area* limitation specified in Table 503 shall be increased 200% for one-and two-story buildings and 100% for buildings more than two stories in *height*.

506.4 Multistory buildings: The *area* limitations for buildings two stories in *height* shall be the same as the area limitations provided in Table 503 for one-story buildings. In buildings over two stories in *height*, the *area* limitations of Table 503 for one-story buildings shall be reduced as specified in Table 506.4.

Table 506.4
REDUCTION OF AREA LIMITATIONS

Number of stories	Type of Construction		
	1A & 1B	2A	2B, 2C, 3A, 3B, 4, 5A, 5B
1	None	None	None
2	None	None	None
3	None	5%	20%
4	None	10%	20%
5	None	15%	30%
6	None	20%	40%
7	None	25%	50%
8	None	30%	60%
9	None	35%	70%
10	None	40%	80%

780 CMR 507.0 UNLIMITED AREAS

507.1 One-story buildings: For all occupancies other than Use Groups A-l, A-2, A-4, A-5, E, H, I-l, I-3 and R, the *area* of buildings that do not exceed one story and 85 feet (25908 mm) in *height*, other than buildings of Type 5 construction, shall not be limited, provided that the building is equipped throughout with an *automatic sprinkler system* in accordance with 780 CMR 906.2.1; and the building is isolated as specified in 780 CMR 507.2. Buildings with an occupancy in Use Group I-2 shall not be constructed of Type 3B construction. ***Except as modified by 780 CMR 9***, *fire areas* of Use Group E are permitted in unlimited area buildings in accordance with 780 CMR 507.1.1. *Except as modified by 780 CMR 9, fire areas* of Use Groups H-2, H-3 and H-4 are permitted in unlimited area buildings in accordance with 780 CMR 507.1.2. *Bulk Merchandising Retail Buildings* designed, constructed and operated in accordance with 780 CMR 426.0 shall be permitted to be constructed of unlimited area."

Exceptions:

1. Buildings and structures of special industrial occupancies in accordance with 780 CMR 503.1.1 shall be exempt from the above *height* limitations and *fire separation distance* requirements, and the *automatic fire suppression system* shall not be provided where such installations will be detrimental or dangerous to the specific occupancy as approved by the code official. Where located with a *fire separation distance* of less than 30 feet (9144 mm), the exterior walls of such buildings shall be *protected* or constructed to provide a fireresistance rating of not less than two hours.
2. An *automatic fire suppression system* shall not be required for buildings of Type 2 or Type 4 construction which are occupied exclusively for the storage of noncombustible materials that are not packed or crated in combustible materials.
3. Buildings and structures of Types 1 and 2 construction for rack storage facilities which do not have access by the public shall not be limited in *height* provided that such buildings conform to the requirements of 780 CMR 507.1 and NFiPA 231 C listed in ***Appendix A***.
4. The *automatic sprinkler system* shall not be required in areas occupied for indoor participant sports, such as tennis, skating, swimming and equestrian activities, in occupancies in Use Group A-3 provided that:
    4.1.. *Exit* doors directly to the outside are provided for all occupants of the participant sport areas; and
    4.2. The building is equipped with a fire protective signaling system with manual fire alarm boxes installed in accordance with 780 CMR 917.0.

507.1.1 School buildings: For occupancies in Use Group E, one-story buildings of Type 2, 3A or 4 construction shall not be limited in *area* where a direct *exit* to the outside of the building is provided from each classroom and the building is equipped throughout with an *automatic sprinkler system* in accordance with 780 CMR 906.2.1. Exterior walls on all sides of such buildings shall comply with 780 CMR 507.2.

507.1.2 High-hazard use groups: Use Group H-2, H-3 and H-4 *fire areas* shall be permitted in occupancies in Use Groups F and S ***except as modified by 780 CMR 9***, and in lecture halls and laboratories in Use Groups A-3, B, E and I-2 in accordance with the limitations of 780 CMR 507.1. *Fire areas* located at the perimeter of the building shall not exceed the area limitations specified in Table 503 as modified by 780 CMR 506.2, based upon the percentage of the perimeter of the *fire area* that fronts on a street or other unoccupied space. Interior *fire areas* shall not exceed 25% of the area limitations specified in Table 503. Fireresistance rating requirements of *fire separation assemblies* shall be in accordance with Table 313.1.2.

507.2 Exterior walls: The minimum fireresistance rating of exterior walls of one-story buildings of unlimited area shall be determined by the use group and the *fire separation distance* as specified in Table 507.2, but shall not be less than the fireresistance rating required by Table 602 for the type of construction. The entire perimeter of one-story unlimited *area* buildings shall have a minimum *fire separation distance* of 30 feet (9144 mm).

Exception: The minimum *fire separation distance* of 30 feet (9144 mm) shall not apply to a wall facing another building on the same *lot*, provided that:

1. Such wall is constructed as a *fire wall* in accordance with 780 CMR 707.0;
2. The length of the *fire wall* does not exceed 25% of the total perimeter of the unlimited area building;
3. The adjacent building has a minimum *fire separation distance* of 30 feet (9144 mm) on all sides, except for the side that faces the unlimited area building; and
4. The adjacent building is equipped throughout with an *automatic sprinkler system* in accordance with 780 CMR 906.2.1.

507.2.1 Opening protective: Openings in exterior walls required by Table 507.2 to have a fire resistance rating of three hours or more shall be *protected* with fire assemblies having a fire resistance rating of not less than three hours. Openings in exterior walls required by Table 507.2 to have a fire resistance rating of two hours shall be *protected* with fire assemblies having a fire protection rating of not less than 1½ hours.

Table 507.2
MINIMUM FIRE RESISTANCE RATING OF EXTERIOR WALLS

Use Group	Fireresistance rating (hours) based on fire separation distance[a]	
	30 Feet or greater but less than 50 feet	50 feet or greater
E	1½	0
A-3, B, F-2, I-2, S-2	2	0
F-1, M, S-1	3	0

Note a. 1 foot = 304.8 mm.

CHAPTER 6

TYPES OF CONSTRUCTION

780 CMR 601.0 GENERAL

601.1 Scope: The provisions 780 CMR 6 shall control the classification of all buildings as to type of construction.

601.2 Application of other laws: The provisions of 780 CMR 6 shall not be deemed to nullify any provisions of the *zoning* law or any other statute of the jurisdiction pertaining to the location or type of construction of buildings, except as is specifically required by the provisions of 780 CMR.

601.3 Hospitals: Pursuant to M.G.L. c. 111, § 51, hospitals other than college and school infirmaries shall be constructed of at least Type 1B construction.

780 CMR 602.0 CONSTRUCTION CLASSIFICATION

602.1 General: All buildings and structures erected or to be erected, altered or extended in *height* or *area* shall be classified in one of the five construction types defined in Table 602 and 780 CMR 603.0 through 606.0.

602.2 False designation: A building shall not be designated as a given type of construction unless it conforms to the minimum requirements for that type.

602.3 Minimum requirements: Where a type of construction is used that is superior to the minimum herein required for any specified use, *height* and area of the building, nothing in 780 CMR shall be construed to require full compliance with the specifications for the higher type; but the designated construction classification of the building shall be that of the lesser type, unless all of the requirements for the higher type are fulfilled.

602.4 Noncombustibility requirements: Where a structure or a part of a structure is required to be constructed of noncombustible construction, the use of combustible elements shall be permitted subject to the limitations of 780 CMR 602.0 without altering the construction classification.

602.4.1 Roofs, floors and walls: Combustible elements in roofs, floors and walls are permitted to be used for the following components:

1. Interior finish and trim materials as regulated by 780 CMR 803.0, 804.0 and 806.0.
2. Light-transmitting *plastics* as permitted by 780 CMR 26.
3. Fireretardant-treated wood complying with 780 CMR 2310.0 as permitted by Table 602.
4. Mastics and caulking materials applied to provide flexible seals between components of exterior wall construction.
5. Roof covering materials as regulated by 780 CMR 15.
6. Thermal and sound insulation as permitted by 780 CMR 707.4.722.0. 1509.0. 2309.4 and 2603.0.
7. Exterior veneer and trim as permitted by 780 CMR 1406.0.
8. Nailing or furring strips as permitted by 780 CMR 804.0.
9. Windows and doors as permitted by 780 CMR 706.4.
10. Heavy timber as permitted by 780 CMR 1006.3.1, 714.2 and 714.4.
11. Partitions as permitted by 780 CMR 603.2.
12. Roof structures as permitted by 780 CMR 1510.0.
13. Platforms as permitted by 780 CMR 412.4.1.

602.4.2 Ducts: The use of nonmetallic ducts is permitted in accordance with the mechanical code listed in *Appendix A*.

602.4.3 Piping: The use of combustible piping materials is permitted in accordance with the mechanical and plumbing codes listed in *Appendix A*.

602.4.4 Electrical: The use of insulated electrical wiring and related components is permitted in accordance with 527 CMR listed in *Appendix A*.

Table 602
FIRE RESISTANCE RATINGS OF STRUCTURE ELEMENTS[k]

		Type of construction 780 CMR 602.0									
		Noncombustible					Noncombustible/Combustible			Combustible	
		Type 1 780 CMR 603.0		Type 2 780 CMR 603.0			Type 3 780 CMR 604.0		Type 4 780 CMR 605.0	Type 5 780 CMR 606.0	
Structure element		Protected		Protected		Unprotected	Protected	Unprotected	Heavy timber Note c	Protected	Unprotected
Note a		1A	1B	2A	2B	2C	3A	3B	4	5A	5B
1 Exterior walls	Loadbearing	4	3	2	1	0	2	2	2	1	0
		← Not less than the rating based on fire separation distance (see 780 CMR 705.2) →									
	Nonloadbearing	← Not less than the rating based on fire separation distance (see 780 CMR 705.2) →									
2 Fire walls and party walls (780 CMR 707.0)		4	3	2	2	2	2	2	2	2	2
		←Not less than the fireresistance rating required by Table 707.1 →									
3 Fire separation assemblies (780 CMR 709.0)	Fire enclosure of exits (780 CMR 1014.11, 709.0 and Note b)	2	2	2	2	2	2	2	2	2	2
	Shafts (other than exits) & elevator hoistway (780 CMR 709, 710.0 & Note b)	2	2	2	2	2	2	2	2	1	1
	Mixed use & fire area separations (780 CMR 313.0)	← Not less than the fireresistance rating required by Table 313.1.2 →									
	Other Separation assemblies (Note i)	1	1	1	1	1	1	1	1	1	1
		←Note d →									
4 Fire partitions (780 CMR 711.0)	Exit access corridors (Note g)	← Not less then the fireresistance rating required by 780 CMR 1011.4 →									
		←Note d →									
	Tenant spaces separations (Note f)	1	1	1	1	0	1	0	1	1	0
		←Note d →									
5 Dwelling unit separations (780 CMR 711.0, 713.0 & Notes f & j)		1	1	1	1	1	1	1	1	1	1
		←Note d →									
6 Smoke barriers (780CMR 712.0 & Note g)		1	1	1	1	1	1	1	1	1	1
7 Other nonloadbearing partitions		0	0	0	0	0	0	0	0	0	0
		←Note d→									
8 Interior loadbearing walls, loadbearing partitions, columns, girders, trusses (other than roof trusses) & framing (780 CMR 715.0)	Supporting more than one floor	4	3	2	1	0	1	0	See 780 CMR 605.0	1	0
	Supporting one floor only or a roof only	3	2	1½	1	0	1	0	See 780 CMR 605.0	1	0
9 Structural members supporting wall (780 CMR 715.0 & Note g)		3	2	1½	1	0	1	0	1	1	0
		←Not less than fireresistance rating of wall supported →									
10 Floor construction including beams (780 CMR 713.0 & Note h)		3	2	1½	1	0	1	0	See 780 CMR 605.0, Note c	1	0
11 Roof construction, including beams, trusses and framing, arches & roof deck (780 CMR 714.0 & Notes e, i)	15' or less in height to lowest member	2	1½	1	1	0	1	0	See 780 CMR 605.0, Note c	1	0
				←Note d →							
	More than 15' but less than 20' in height to lowest member	1	1	1	0	0	0	0	See 780 CMR 605.0	1	0
		←Note d →									
	20' or more in height to lowest member	0	0	0	0	0	0	0	See 780 CMR 605.0	0	0
		←Note d →									

Note a. For fireresistance rating requirements for structural membranes and assemblies which support other fireresistance rated members or assemblies, see 780 CMR 715.1.

Note b. For reductions in the required fireresistance rating of exit and shaft enclosures, see 780 CMR 1014.11 and 710.3

Note c. For substitution of other structural materials for timber in Type 4 construction, see 780 CMR 2304.2.

Note d. For fire retardant-treated wood permitted in roof construction and nonloadbearing walls where the required fireresistance rating is one hour or less, see 780 CMR 603.2 and 2310.0.

Note e. For permitted uses of heavy timber in roof construction in buildings of Types 1 and 2 construction, see 780 CMR 714.4.

Note f. For reductions in required fireresistance ratings of tenant separations and dwelling unit separations, see 780 CMR 1011.4 and 1011.4.1.

Note g. For exceptions to the required fireresistance rating of construction supporting exit access corridor walls, tenant separation walls in covered mall buildings, and smoke barriers, see 780 CMR 711.4 and 712.2.

Note h. For buildings having habitable or occupiable stories or basements below grade, see 780 CMR 1006.3.1.

Note i. Not less than the rating required by 780 CMR.

Note j. For Use Group R-3, see 780 CMR 310.5.

Note k. Fireresistance ratings are expressed in hours.

Note l. 1 foot = 304.8 mm.

780 CMR 603.0 TYPES 1 AND 2 CONSTRUCTION

603.1 General: Buildings and structures of Types 1 and 2 construction are those in which the walls, partitions, structure elements, floors, ceilings, roofs and *exits* are constructed of approved noncombustible materials. Each structure element shall not be less than the required fireresistance rating specified in Table 602, except as otherwise specifically provided for in 780 CMR. Buildings of Types 1 and 2 construction shall be further classified as Type 1A, 1B, 2A, 2B or 2C. Fireretardant-treatedwood shall only be used as specified in Table 602 and 780 CMR 2310.0.

603.2 Interior partitions: In buildings or structures of Types 1, 2A and 2B construction, partitions of a single thickness of wood or approved composite panels, and glass or other approved materials of similar combustible characteristics, are permitted to subdivide rooms or spaces into offices, entries or other similar compartments in all occupancies other than Use Groups I and R, provided that such partitions neither establish a *corridor* serving an occupant load of more than 30 in areas occupied by a single tenant nor exceed 5,000 square feet (465 m^2) between *fire separation assemblies* or *fire walls*. The maximum allowable compartment size shall be increased to 7,500 square feet (700 m^2) where subdivided with fireretardant-treated wood that complies with 780 CMR 2310.0.

780 CMR 604.0 TYPE 3 CONSTRUCTION

604.1 General: Buildings and structures of Type 3 construction are those in which: the exterior walls are constructed of masonry or other approved noncombustible materials; the interior structure elements, loadbearing walls, partitions, floors and roofs are constructed of any approved materials. Each structure element shall have not less than the required fireresistance rating specified in Table 602, except as otherwise specifically provided for in 780 CMR. Buildings of Type 3 construction shall be further classified as Type 3A or 3B.

780 CMR 605.0 TYPE 4 CONSTRUCTION

605.1 General: Buildings and structures of Type 4 construction are those in which the exterior walls are constructed of approved noncombustible materials and the interior structural members are of solid or laminated wood without concealed spaces or the loadbearing walls, partitions, floors and roofs are constructed of any noncombustible materials permitted by 780 CMR. Each structure element shall have not less than the required fireresistance rating specified in Table 602. The elements of Type 4 construction shall comply with the provisions of 780 CMR 2304.0.

780 CMR 606.0 TYPE 5 CONSTRUCTION

606.1 General: Buildings and structures of Type 5 construction are those in which the exterior walls, loadbearing walls, partitions floors and roofs are constructed of any approved materials. Each structure element shall have not less than the required fireresistance rating specified in Table 602. Buildings of Type 5 construction shall be further classified as Type 5A or 5B.

NON-TEXT PAGE

CHAPTER 7

FIRERESISTANT MATERIALS AND CONSTRUCTION

780 CMR 701.0 GENERAL

701.1 Scope: The provisions of 780 CMR 7 shall govern the design and installation of all materials and methods of construction in respect to required fireresistance rating and flameresistance, as determined by the potential fire hazard of the use and occupancy of the building or structure and the location and function of all integral structural and other fireresistive elements of the building; and the installation of safeguards against the spread of fire to and from adjoining structures.

701.2 Performance standards: The requirements of 780 CMR 7 shall constitute the minimum functional performance standards for fire protection purposes; and shall not be deemed to decrease or waive any strength provisions or in any other manner decrease the requirements of 780 CMR in respect to structural safety.

701.3 Combustible materials: All materials and forms of construction which develop the fireresistance ratings required by 780 CMR shall be acceptable for fireproofing and structural purposes, except that combustible component materials in structural units or structural assemblies shall be limited in the types of construction specified in 780 CMR 603.0,604.0 and 605.0, and in 780 CMR 701.3.1.

701.3.1 Combustible components: Combustible aggregates are permitted in gypsum concrete mixtures approved for fireresistance rated construction. Any approved component material or admixture is permitted in assemblies that meet the fireresistive test requirements of 780 CMR.

780 CMR 702.0 DEFINITIONS

702.1 General: The following words and terms shall, for the purposes of 780 CMR 7 and as used elsewhere in 780 CMR, have the meanings shown herein.

Damper, fire: A damper arranged to seal off air flow automatically through part of an air duct system, so as to restrict the passage of heat. The fire damper shall not be used as a smoke damper unless the location lends itself to the dual purpose (see 780 CMR 717.0).

Door assembly, fire: A combination of the *fire door*, frame, hardware and other accessories which together provide a specific degree of fire protection to the opening (see 780 CMR 716.0).

Door, fire: A door and its assembly, so constructed and assembled in place as to give protection against the passage of fire (see 780 CMR 716.0).

Draftstopping: Building materials installed to prevent the movement of air, smoke, gases and flame to other areas of the building through large concealed passages such as *attic* spaces and floor assemblies with suspended ceilings or openweb trusses (see 780 CMR 720.0).

Fire area: The aggregate floor area enclosed and bounded by *fire walls*, exterior walls or *fire separation assemblies* of a building (see 780 CMR 709.2).

Fire partition: A vertical assembly of materials having protected openings and designed to restrict the spread of fire (see 780 CMR 711.0).

Fire protection rating: The time in hours, or fractions thereof, that an opening protective assembly will resist fire exposure as determined by the test standard specified in 780 CMR (see 780 CMR 706.0,716.0 and 718.0).

Fire separation assembly: A horizontal or vertical fireresistance rated assembly of materials having protected openings, and designed to restrict the spread of fire (see 780 CMR 709.0).

Fire separation distance: The distance in feet measured from the building face to the closest *interior lot line*, to the center-line of a street or *public way* or to an imaginary line between two buildings on the same property.

Fire window: A window constructed and glazed to give protection against the passage of fire (see 780 CMR 718.0).

Fireresistance: That property of materials or their assemblies which prevents or retards the passage of excessive heat, hot gases or flames under conditions of use.

Fireresistance rating: The time in hours or fractions thereof that materials or their assemblies will resist fire exposure as determined by the fire test specified in 780 CMR (see 780 CMR 704.1.1).

Firestopping: Building materials installed to prevent the movement of flame and gases to other areas of a building through small concealed passages in building components such as floors walls and stairs (see 780 CMR 720.0).

Protected construction: That in which all structural members are constructed, chemically treated, covered or protected so that the individual unit or the combined assemblage of all such units has the required fireresistance rating specified for its particular application in Table 602; and includes protected combustible and protected noncombustible construction.

Self-closing: As applied to a *fire door* or other opening protective, means normally closed and equipped with an approved device which will insure closing after having been opened for use (see 780 CMR 716.5).

Shaft: An enclosed space extending through one or more stories of a building, connecting vertical openings in successive floors, or floors and the roof (see 780 CMR 710.0).

Single membrane penetration: An opening through a single membrane (one side) of a fireresistance rated wall, roof/ceiling or floor/ceiling assembly made to accommodate pipes, tubes, conduits, vents, wires, cables, electrical outlet boxes and similar items (see 780 CMR 709.6.5).

Smoke barrier: A continuous membrane that will resist the movement of smoke (see 780 CMR 712.0).

Smoke compartment: A space within a building enclosed by smoke barriers or *fire separation assemblies* on all sides, including top and bottom (see 780 CMR 712.0).

Through-penetration protection system: Specific building materials or assemblies of materials that are designed and installed to prevent the spread of fire through openings that are made in fireresistance rated floors and walls to accommodate through-penetrating items such as pipes, tubes, conduits, vents, wires, cables and similar items. The F rating indicates the period of time that the through-penetration protection system is capable of preventing the passage of flame to the unexposed (nonfire) side of the assembly in conjunction with an acceptable hose stream test performance. The T rating indicates the period of time that the through-penetration protection system is capable of preventing the passage of flame and a maximum individual temperature rise of 325°F (163°C) above ambient temperature on the unexposed (nonfire) side of the assembly in conjunction with acceptable hose stream test performance (see 780 CMR 707.7.2, 709.6.1 and 713.4.1).

Vertical opening: An opening through a floor or roof.

Wall

Fire separation wall: A fireresistance rated assembly of materials having protected openings which is designed to restrict the spread of fire (see 780 CMR 709.0).

Fire wall: A fireresistance rated wall having protected openings, which restricts the spread of fire and extends continuously from the foundation to or through the roof (see 780 CMR 707.0).

Party wall: A *fire wall* on an *interior lot line* used or adapted for joint service between two buildings (see 780 CMR 707.0).

780 CMR 703.0 CONSTRUCTION DOCUMENTS

703.1 General: *Construction documents* for all buildings shall designate the type of construction and the fireresistance rating of all structure elements as required by 780 CMR. The *construction documents* shall include documentation or supporting data substantiating all required fireresistance ratings.

703.2 Penetrations: *Construction documents* for buildings more than two stories in *height* shall indicate where penetrations will be made for electrical, mechanical, plumbing and communication conduits, pipes and systems, and shall also indicate the materials and methods for maintaining the required structural integrity, fireresistance rating and *firestopping*.

780 CMR 704.0 FIRE TESTS

704.1 General: Building elements and assemblies including loadbearing and nonloadbearing walls and partitions, columns, girders, beams, slabs and floors and roof assemblies, shall provide the minimum fireresistance ratings specified in Table 602 for the type of construction unless otherwise required by the provisions of 780 CMR.

704.1.1 Fireresistance ratings: The fireresistance ratings of building assemblies and structural elements shall be determined in accordance with the test procedures set forth in ASTM E119 listed in ***Appendix A***, specific methods as provided for herein, or shall be determined in accordance with an approved analytical method. Where an approved analytical method is utilized to establish the fireresistance rating of a structural element or building assembly, the calculations shall be based upon the fire exposure and acceptance criteria specified in ASTM E 119 listed in *Appendix A*.

Exception: In determining the fireresistance rating of exterior loadbearing walls, compliance with the ASTM E119 criteria for unexposed surface temperature rise and ignition of cotton waste due to passage of flame or hot gases, is required only for a period of time corresponding to the required fireresistance rating of an exterior nonloadbearing wall with the same *fire separation distance*, and in a building of the same use group. Where the fireresistance rating determined in accordance with this exception exceeds the fireresistance rating determined in accordance with ASTM E119 listed in ***Appendix A***, the fire exposure time period, water pressure and application duration criteria for the hose stream test of ASTM E119 listed in ***Appendix A***, shall be based upon the fireresistance rating determined in accordance with this exception.

704.2 Alternative protection: Where documentation is submitted to the code official and approved, fireresistive coverings or insulating enclosing materials are not required for structural framing elements. Such documentation shall show that the structural integrity of structural framing elements will not be reduced below a safe level by a fire within the building or in an adjacent building having a severity corresponding to the fireresistance rating required for the elements through the installation of heat shields, separations or other approved means of *protection*.

704.3 Opening protectives: Opening protectives shall include the *fire door*, fire shutter, *fire window* or *fire damper* and all required hardware, anchorage, frames and sills necessary for the assembly.

704.4 Combustibility tests: Where the behavior of materials under exposure to fire is specified in 780 CMR, the characteristics of materials shall be determined by the tests and criteria set forth in 780 CMR 704.4.1, 704.4.1.1 and 704.4.1.2.

704.4.1 Tests: The tests indicated in 780 CMR 704.4.1.1 and 704.4.1.2 shall serve as criteria for acceptance of building materials as set forth in 780 CMR 603.0, 604.0 and 605 governing the combustibility of building materials in Types 1, 2, 3 and 4 construction. The term "noncombustible" does not apply to the flame spread characteristics of interior finish or trim materials. A material shall not be classified as a noncombustible building construction material which is subject to an increase in the combustible or flame spread rating beyond the limitations herein established through the effects of age, moisture or other atmospheric conditions.

704.4.1.1 Elementary materials: Materials which are intended to be classified as noncombustible shall be tested in accordance with ASTM E136 listed in ***Appendix A***. Such materials shall be acceptable as noncombustible materials when at least three of four specimens tested conform to all of the following criteria:

1. The recorded temperature of the surface and interior thermocouples shall not at any time during the test rise more than 54°F (30°C) above the furnace temperature at the beginning of the test.
2. There shall not be flaming from the specimen after the first 30 seconds.
3. If the weight loss of the specimen during testing exceeds 50%, the recorded temperature of the surface and interior thermocouples shall not at any time during the test rise above the furnace air temperature at the beginning of the test, and there shall not be flaming of the specimen.

704.4.1.2 Composite materials: Materials having a structural base of noncombustible material as defined in 780 CMR 704.4.1.1. with a surfacing not more than ⅛ inch thick which has a flame spread rating not greater than 50 when tested in accordance with ASTM E84 listed in, ***Appendix A*** shall be acceptable as noncombustible materials.

780 CMR 705.0 EXTERIOR WALLS

705.1 General: All exterior walls shall comply with the applicable provisions of 780 CMR and with the fireresistance rating requirements of 780 CMR 705.0 and 780 CMR 602.0.

Exception: The provisions of 780 CMR 705.2 and 705.3 shall not apply to exterior walls which face buildings on the same *lot* where the buildings are such that, if combined into one structure, the resulting building will otherwise comply with the *height* and *area* limitations of 780 CMR 503.0 (see 780 CMR 503.1.3).

705.1.1 Omission of exterior walls: The provisions of 780 CMR shall not be deemed to prohibit the omission of exterior walls for all or part of a story where the provisions of 780 CMR 705.2 do not require a nonloadbearing exterior wall to provide a fireresistance rating, and where the provisions of 780 CMR 705.3 and 705.4 do not limit the maximum percentage of unprotected openings. Except as otherwise specifically permitted in 780 CMR 715.5, the piers, columns and other structural elements within the open portion shall be constructed with the fireresistance rating required for exterior loadbearing walls in Table 602.

705.1.2 Combustible exterior wall finish and trim: In addition to the requirements of 780 CMR 705.0, combustible materials installed as *exterior wall finish*, half-timbering, balconies and similar appendages, bay and *oriel windows* and light-transmitting *plastic* panels, shall meet the applicable requirements of 780 CMR 1406.0, 2604.0, 2605.0 and 2606.0.

705.2 Fireresistance ratings: The fireresistance rating of exterior walls shall comply with Table 705.2. Loadbearing exterior walls shall also comply with the fireresistance rating requirements of 780 CMR 602.0. The fireresistance rating of exterior walls with a *fire separation distance* of greater than five feet (1524 mm) shall be rated for exposure to fire from the inside. The fireresistance rating of exterior walls with a *fire separation distance* of five feet (1524 mm) or less shall be rated for exposure to fire from both sides.

Table 705.2
EXTERIOR WALL FIRERESISTANCE RATINGS[b]

Fire Separation distance (feet)[c]	Use Group[a]				
	H-2	F-1, H-3, M, S-1	R-2	R-3	A, B, E, F-2, H-4, I, R-1, S-2
0 to 5	4	3	1	1	2
Greater than 5 to 10	3	2	1	0	1
Greater than 10 to 15	2	1	0	0	0
Greater than 15to 30	1	0	0	0	0
Greater than 30	0	0	0	0	0

Note a. For requirements for Use Group H-1, see 780 CMR 705.2.1.
Note b. Fireresistance ratings are expressed in hours.
Note c. 1 foot - 304.8 mm.

705.2.1 Use Group H-1: Buildings and structures with an occupancy in Use Group H-1 shall be located in accordance with the requirements for the storage of *explosives* in the fire prevention code listed in ***Appendix A***. The allowable quantities of Use Group H-1 materials shall be based on the TNT equivalency of the materials. The *exterior finish* surface of all exterior walls in an occupancy in Use Group H-1 shall be of approved noncombustible materials or fireretardant-treated wood complying with 780 CMR 2310.0 for exterior installation.

705.2.2 Wall support: The wall shall extend to the height required by 780 CMR 705.6, and shall be supported such that the wall will remain in place for the duration of time indicated by the required fireresistance rating.

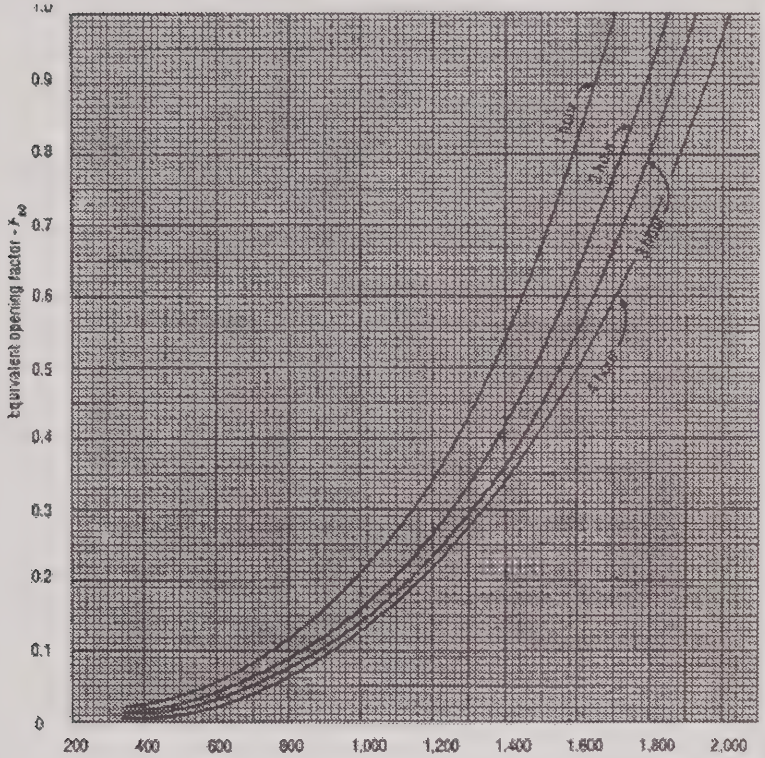
705.2.3 Automatic fire suppression: In buildings equipped throughout with an *automatic sprinkler system* in accordance with 780 CMR 906.2.1, the required fireresistance rating of nonloadbearing exterior walls shall be reduced by one hour, except that where the *fire separation distance* is five feet (1524 mm) or less, the fireresistance rating shall not be reduced to less than one hour. This reduction shall not apply to occupancies in Use Group H.

705.2.4 Unexposed surface temperature: Where protected openings are not limited by Table 705.3, the limitation on the rise of temperature on the unexposed surface of exterior walls as required by ASTM E119 listed in ***Appendix A*** shall not apply. Where protected openings are limited by Table 705.3, the limitation on the rise of temperature on the unexposed surface of exterior walls as required by ASTM E119 listed in ***Appendix A*** shall not apply provided that a correction is made for radiation from the unexposed exterior wall surface in accordance with the following formula:

$$A_e = A + (A_f \times F_{eo}) \quad \text{where:}$$

A_e = Equivalent area of protected openings.
A = Actual area of protected openings.
A_f = Area of exterior wall surface in the story under consideration exclusive of openings, on which the temperature limitations of ASTM E119 listed in ***Appendix A*** for walls is exceeded.
F_{eo} = An "equivalent opening factor" derived from Figure 705.2.4 based on the average temperature of the unexposed wall surface and the fireresistance rating of the wall required by 780 CMR 705.2.

Figure 705.2.4
EQUIVALENT OPENING FACTOR



Average temperature of unexposed surface (degrees F)

705.3 Openings: The maximum area of unprotected or protected openings permitted in an exterior wall in any story shall not exceed the values set forth in Table 705.3. Where both unprotected and protected openings are located in the exterior wall in any story, the total area of the openings shall comply with the following formula:

$$\frac{A}{a} + \frac{A_u}{a_u} \leq 1.0$$

where:

A = Actual area of protected openings, or the equivalent area of protected openings A_e (see 780 CMR 705.2.4).

a = Allowable area of protected openings.

A_u = Actual area of unprotected openings.

a_u = Allowable area of unprotected openings.

Table 705.3
MAXIMUM AREA OF EXTERIOR WALL OPENINGS[a]

Classification of opening	Fire separation distance (feet)[e]							
	0 to 3	> 3 to 5	> 5 to 10[d]	> 10 to 15[c,d]	> 15 to 20[c]	> 20 to 25[c]	> 25 to 30[c]	> 30
Unprotected	NP	NP[b]	10%	15%	25%	45%	70%	No limit
Protected	NP	15%	25%	45%	75%	No Limit	No Limit	No Limit

NP (Not permitted)

Note a. Values given are percentages of the area of the exterior wall. This table assumes that the openings are reasonably uniformly distributed. Where openings are not reasonably uniformly distributed, the portion of the wall utilized to calculate compliance with table 705.3 shall be approved.

Note b. For occupancies in Use Group R-3, the maximum percentage of unprotected exterior wall openings shall be 5%.

Note c. The area of openings in an open parking structure with a fire separation distance of greater than ten feet shall not be limited.

Note d. For occupancies in Use Group H-2 or H-3, unprotected openings shall not be permitted for openings with a fire separation distance of 15 feet or less.

Note e. One foot = 304.8 mm.

705.3.1 Automatic fire suppression: In buildings equipped throughout with an *automatic sprinkler system* in accordance with 780 CMR 906.2.1, the maximum allowable area of unprotected openings in all occupancies other than Use Groups H-1, H-2 and H-3 shall be the same as the tabulated limitations for protected openings.

705.3.2 First story: In all occupancies other than Use Group H, unlimited unprotected openings are permitted in the first story of exterior walls facing a street which have a *fire separation distance* of greater than 15 feet (4572 mm).

705.4 Vertical separation of openings: Openings in exterior walls in adjacent stories shall be separated vertically to protect against fire spread on the exterior of the buildings where the openings are within five feet (1524 mm) of each other horizontally and the opening in the lower story is not a protected opening in accordance with 780 CMR 706.0. Such openings shall be separated vertically at least three feet (914 mm) by spandrel girders, exterior walls or other similar assemblies which have a fireresistance rating of at least one hour or by flame barriers which extend horizontally at least 30 inches (762 mm) beyond the exterior wall. Flame barriers shall also have a fireresistance rating of at least one hour. The unexposed surface temperature limitations specified in ASTM E119 listed in ***Appendix A*** shall not apply to the flame barriers or vertical separation unless otherwise required by the provisions of 780 CMR.

Exceptions:

1. 780 CMR 705.4 shall not apply to buildings that are three stories or less in *height*.
2. 780 CMR 705.4 shall not apply to buildings equipped throughout with an *automatic sprinkler* system in accordance with 780 CMR 906.2.1.

705.5 Vertical exposure: Approved protectives shall be provided in every opening that is less than 15 feet (4572 mm) vertically above the roof of an adjoining building or adjacent structure which is within a horizontal *fire separation distance* of 15 feet (4572 mm) of the wall in which the opening is located, unless such roof construction affords a fireresistance rating of not less than one hour.

705.6 Continuity of exterior walls: Exterior walls required to be fireresistance rated by 780 CMR 705.2 because of *fire separation distance*, shall be continuous from the foundation to not less than 30 inches (762 mm) above the roof surface.

Exceptions:

1. Where the roof deck or sheathing is constructed of approved noncombustible materials or of fireretardant-treated wood or of ⅝-inch Type X gypsum board supported directly beneath the underside of the roof sheathing or deck, using minimum two-inch ledgers attached to the sides of the roof framing members for a minimum distance of four feet (1219 mm) from the exterior wall, and where the roof covering has a minimum of a Class C rating, the exterior wall shall be permitted to stop at the underside of the roof deck or sheathing.
2. Exterior walls in buildings not exceeding 1,000 square feet (93 m^3) in *area*.
3. Exterior walls of occupancies in Use Group R-3.
4. Exterior walls of a building where the roof has an angle of more than 20 degrees (0.35 rad) with the horizontal.

780 CMR 706.0 EXTERIOR OPENING PROTECTIVES

706.1 Where required: Exterior opening protectives shall be provided in all exterior wall openings that are required to be protected by 780 CMR 705.0.

706.2 Automatic protection: Approved fire protective assemblies shall be fixed, self-closing or equipped with approved automatic-closing devices and shall conform to the requirements of 780 CMR 706.0 and 780 CMR 702.0, 716.0, 717.0, 718.0 and 719.0.

Exception: Fire protective assemblies are not required where outside automatic *sprinklers* are installed for the protection of the exterior openings. The *sprinklers* shall be installed in accordance with NFiPA 13 listed in *Appendix A*, and shall have an *automatic water supply* and be provided with a fire department connection.

706.3 Fireresistance rating: Exterior openings required to be protected by 780 CMR 705.3, when located in a wall required by 780 CMR 705.2 to have a fireresistance rating of greater than one hour, shall be protected with an assembly having a *fire protection rating* of not less than 1½ hours. Exterior openings required to be protected by 780 CMR 705.3, when located in a wall required by 780 CMR 705.2 to have a fireresistance rating of one hour, shall be protected with an assembly having a *fire protection rating* of not less than ¾ hour. Exterior openings required to be protected by 780 CMR 705.4 or 705.5 shall be protected with an assembly having a *fire protection rating* of not less than ¾ hour.

706.4 Unprotected openings: Where protected openings are not required by 780 CMR 705.0, windows and doors shall be constructed of any approved materials. Glazing shall conform to the requirements of 780 CMR 14, 24 and 26.

780 CMR 707.0 FIRE WALLS AND PARTY WALLS

707.1 General: Walls shall have sufficient structural stability under fire conditions to allow collapse of construction on either side without collapse of the wall, and shall be constructed of any approved noncombustible materials that provide the required strength and fireresistance rating specified in Table 602 for the type of construction, but not less than the fireresistance rating of the use group specified in Table 707.1. Strength and stability shall comply with the provisions of 780 CMR 14 and 16.

Table 707.1
FIRE AND PARTY WALL
FIRERESISTANCE RATINGS

Use Group[a]	Minimum Fireresistance rating (hours)
A-3, A-4, A-5, B, E, F-2, H-4, I-1, I-2, R, S-2	2
A-1, A-2, F-1, H-3, I-3, M, S-1	3
H-2	4

Note a. For requirements for Use Group H-1, see 780 CMR 707.1.1.

707.1.1 Use Group H-1: Occupancies in Use Group H-1 shall not be located in a building that: is more than one story in *height*, has a *basement*; or is attached to another building. An occupancy in any use group other than H-1 shall not be located in a building with an occupancy in Use Group H-1.

Exception: The story *above grade*, where provided with barricaded construction in accordance with the fire prevention code listed in ***Appendix A***, shall not be considered a *basement*.

707.2 Cutting walls: A wall that is eight inches or less in thickness shall not be cut for chases or socketed for insertion of structural members subsequent to erection (see 780 CMR 2109.1.1).

707.3 Hollow walls: The wall shall not be less than the minimum thickness specified in ACI 530/ASCE 5/TMS 402 listed in ***Appendix A***.

707.4 Combustible insulation: The code official shall permit the application of cork, fiberboard or other combustible insulation where laid up without intervening air spaces and attached directly to the face of the wall, and where protected on the exposed surface as provided for in 780 CMR 722.0 and 2309.1.

707.5 Continuity of walls: In all buildings or structures, walls shall be continuous from foundation to two feet eight inches (813 mm) above the roof surface, except as provided for in 780 CMR 707.5.1 through 707.5.3. *Fire walls* shall be made smoke tight at their junction with exterior walls. In exterior wall construction employing studs, the wall shall extend through the stud space to the exterior sheathing.

707.5.1 Noncombustible roofs: The wall is permitted to terminate at the underside of the roof deck where the roof is of approved noncombustible construction and is properly *firestopped* at the wall.

707.5.2 Combustible roofs: The wall is permitted to terminate at the underside of the roof deck in Types 3, 4 and 5 construction where all of the following conditions are met:

1. The wall is properly *firestopped* at the deck.
2. The roof sheathing or deck is constructed of approved noncombustible materials or of fireretardant-treated wood, for a distance of four feet (1219 mm) on both sides of the wall, or such roof sheathing or deck is constructed with ⅝-inch Type X gypsum board supported directly beneath the underside of the roof sheathing or deck, using minimum two-inch ledgers attached to the sides of the roof framing members, for a minimum distance of four feet (1219 mm) on both sides of the *fire wall*.
3. Combustible material does not extend through the wall.
4. The roof covering has a minimum of a Class C rating.

707.5.3 Noncombustible frame: The wall shall not be supported on the structural frame in buildings of noncombustible construction unless such supporting frame and all members, which under fire conditions provide lateral support for the frame, have a fire resistance at least equal to that required for the wall.

707.6 Offset fire walls: Where *fire walls* are offset at intermediate floor levels in protected skeleton-frame construction, the offset floor construction and the intermediate wall supports shall be constructed of approved noncombustible materials with a fireresistance rating not less than that required for the *fire wall*.

707.7 Penetrations: Penetrations through fire walls shall meet the limitations specified in 780 CMR 707.7.1 through 707.7.4.

707.7.1 Combustible framing: In addition to the provisions of 780 CMR 2305.6, adjacent combustible members entering into a masonry *fire wall* from opposite sides shall not have less than a four-inch (102 mm) distance between embedded ends. Where combustible members frame into hollow walls or walls of hollow units, all hollow spaces shall be solidly filled for the full thickness of the wall and for a distance not less than four inches (102 mm) above, below and between the structural members, with noncombustible materials approved for *firestopping* in accordance with 780 CMR 720.0.

707.7.2 Noncombustible penetrations: Cables and wires without combustible jackets or insulation, and noncombustible pipes, tubes, conduits and vents which penetrate a *fire wall* shall be tested in accordance with ASTM E119 listed in ***Appendix A*** as part of a rated assembly, or shall be protected by an approved *through-penetration protection system* that has been tested in accordance with ASTM E814 listed in ***Appendix A***, or the annular space around the penetrating item shall be protected in accordance with 780 CMR 707.8.

The *through-penetration protection system* shall be tested in accordance with ASTM E814 listed in ***Appendix A***, with a minimum positive pressure differential of 0.01 inch of water column (2.5 P) and shall have an "F" rating of not less than the required rating of the wall penetrated.

707.7.3 Combustible penetrations: Cables and wires with combustible jackets or insulation, and combustible pipes, tubes and conduits which penetrate a *fire wall* shall be tested in accordance with ASTM E119 listed in ***Appendix A*** as part of a fireresistance rated assembly or shall be protected by an, approved *through-penetration protection* system that has been tested in accordance with ASTM E814 listed in ***Appendix A***.

The *through-penetration protection system* shall be tested in accordance with ASTM E814 listed in ***Appendix A***, with a minimum positive pressure differential of 0.01 inch of water column (2.5 P) and shall have an "F" rating of not less than the required rating of the assembly penetrated.

707.7.4 Electrical outlet boxes: Openings for steel electrical outlet boxes that do not exceed 16 square inches (10323 mm^2) in area are permitted provided that the area of such openings does not exceed 100 square inches (64516 mm^2) for any 100 square feet (9.3 m^2) of wall area. Outlet boxes on opposite sides of the wall shall be separated by a horizontal distance of not less than 24 inches (610 mm).

Exception: Openings for electrical outlet boxes of any material are permitted provided that such boxes are tested for use in fireresistance rated assemblies and installed in accordance with the tested assembly.

707.8 Annular space protection: Where permitted by 780 CMR 707.7.2 for noncombustible penetrating items, the annular space between the penetrating item and the fireresistance rated assembly being penetrated shall be protected as specified in 780 CMR 707.8.1 and 707.8.2.

707.8.1 Material: The material used to fill the annular space shall comply with 780 CMR 707.8.1.1 or 707.8.1.2.

707.8.1.1 Concrete or masonry assemblies: Penetrations of concrete or masonry assemblies by a maximum six-inch nominal diameter copper, iron or steel pipe, tube, conduit or wires and cables with steel jackets shall be permitted provided that the maximum opening size is 144 square inches (0.09 m^2) and the penetration is protected with concrete, grout or mortar for the full thickness of the assembly or the thickness required to provide a fireresistance rating equivalent to the required fireresistance rating of the assembly penetrated.

707.8.1.2 All assemblies: In all assemblies the material shall prevent the passage of flame and hot gases sufficient to ignite cotton waste when subjected to the time-temperature fire conditions of ASTM E119 listed in ***Appendix A***, under a minimum positive pressure differential of 0.01 inch of water column (2.5 P) at the location of the penetration for the time period equivalent to the required fireresistance rating of the assembly penetrated.

707.8.2 Sleeves: Where sleeves are installed, the sleeves shall be noncombustible and shall be securely fastened to the assembly penetrated. All space between the item contained in the sleeve and the sleeve itself, and any space between the sleeve and the assembly penetrated, shall be filled with a material that complies with 780 CMR 707.8.1.

780 CMR 708.0 FIRE WALL OPENINGS

708.1 General: Openings in *fire walls* shall not exceed the limitations in size and area herein prescribed.

708.2 Size of opening: Each opening through a *fire wall* shall not exceed 120 square feet (11.16 m^2). The aggregate width of all openings at any floor level shall not exceed 25% of the length of the wall.

Exception: Openings shall not be limited to 120 square feet (11.16 m^2) where both buildings are equipped throughout with an *automatic sprinkler system* installed in accordance with780 CMR 9.

708.2.1 First story: Where the entire first-story floor *areas* on both sides of a *fire wall* are equipped throughout with an approved *automatic sprinkler system* installed in accordance with 780 CMR 906.2.1, the maximum allowable size of openings on the first story of the building shall not exceed 240 square feet (22.32 m^2) with a minimum distance of three feet (914 mm) between adjacent openings.

708.3 Opening protectives: All opening protectives in *fire walls* shall comply with the provisions of 780 CMR 704.0 and shall have the minimum *fire protection rating* as set forth in 780 CMR 716.0.

780 CMR 709.0 FIRE SEPARATION ASSEMBLIES

709.1 General: *Fire separation assemblies* installed for purposes of the enclosure of *exits*, floor openings, *shafts*, areas of refuge and for subdividing purposes shall be constructed of approved materials consistent with the limitations for the building type of construction and shall have not less than the fireresistance rating prescribed by Table 602.

709.2 Fire area: A *fire separation* assembly which separates adjacent *fire areas* shall have a fireresistance rating of not less than the fireresistance rating required by Table 313.1.2 based on the use group of the *fire areas* which are separated.

709.3 Openings: Openings located in a *fire separation assembly* shall be limited to a maximum aggregate width of 25% of the length of the wall, and the maximum area of any single opening shall not exceed 120 square feet (11 m^2). Openings in *exit* enclosures, other than unexposed exterior openings, shall be limited to those necessary for *exit access* to the enclosure from normally occupied spaces and for egress from the enclosure.

> **Exception**: Openings shall not be limited to 120 square feet (11 m^2) where adjoining *fire areas* are equipped throughout with an *automatic sprinkler system* installed in accordance with 780 CMR 9.
>
> **709.3.1 Protectives**: All opening protectives in *fire separation assemblies* shall comply with the provisions of 780 CMR 704.0 and shall have the minimum *fire protection rating* as set forth in 780 CMR 716.0.

709.4 Continuity: All vertical *fire separation assemblies* shall extend from the top of the fireresistance rated floor/ceiling assembly below to the underside of the floor or roof slab or deck above and shall be securely attached thereto. These walls shall be continuous through all concealed spaces such as the space above a suspended ceiling. The supporting construction shall be *protected* to afford the required fireresistance rating of the *fire separation assembly* supported. All hollow vertical spaces shall be *firestopped* at every floor level as required in 780 CMR 720.0.

709.5 Exterior walls: Except as provided for in 780 CMR 1014.11.1 and 1014.12.2, where exterior walls serve as a part of a required fireresistance rated enclosure, such walls shall comply with the requirements of 780 CMR 705.0 for exterior walls and the fireresistance rated enclosure requirements shall not apply.

709.6 Penetrations: Penetrations through fireresistance rated wall assemblies shall meet the limitations specified in 780 CMR 709.6.1 through 709.6.5. Penetrations through floor/ceiling and roof/ceiling assemblies shall comply with 780 CMR 713.0. Penetrations of an *exit* enclosure shall also comply with 780 CMR 1014.11.2.

> **709.6.1 Noncombustible penetrations**: Cables and wires without combustible jackets or insulation, and noncombustible pipes, tubes, conduits and vents which penetrate an assembly shall be tested in accordance with ASTM E119 listed in *Appendix A* as part of a rated assembly, or shall be protected by an approved *through-penetration protection system* that has been tested in accordance with ASST. E814 listed in *Appendix A*, or the annular space around the penetrating item shall be protected in accordance with 780 CMR 709.7.
>
> The *through-penetration protection system* shall be tested in accordance with ASTM E814, with a minimum positive pressure differential of 0.01 inch of water column (2.5 P) and shall have an "F" rating of not less than the required rating of the assembly penetrated.

709.6.2 Combustible penetrations: Cables and wires with combustible jackets or insulation, and combustible pipes, tubes, conduits and vents which penetrate an assembly shall be tested in accordance with ASTM E119 listed in *Appendix A* as part of a fireresistance rated assembly or shall be protected by an approved *through-penetration protection system* that has been tested in accordance with ASTM E814 listed in *Appendix A*.

The *through-penetration protection system* shall be tested in accordance with ASTM E814 with a minimum positive pressure differential of 0.01 inch of water column (2.5 P) and shall have an "F" rating of not less than the required rating of the assembly penetrated.

709.6.3 Electrical outlet boxes: Openings for steel electrical outlet boxes that do not exceed 16 square inches (10323 mm^2) in area are permitted provided that the area of such openings does not exceed 100 square inches (64516 mm^2) for any 100 square feet (9.3 m^2) of enclosure wall area. Outlet boxes on opposite sides of the assembly shall be separated by a horizontal distance of not less than 24 inches (610 mm).

> **Exception**: Openings for electrical outlet boxes of any material are permitted provided that such boxes are tested for installation in fireresistance rated assemblies and installed in accordance with the tested assembly.

709.6.4 Ducts: Ducts that penetrate an assembly shall be provided with approved *fire dampers* that comply with 780 CMR 717.0.

> **Exception**: *Fire dampers* are not required:
>
> 1. In steel exhaust air subducts extending at least 22 inches (559 mm) vertically in an exhaust *shaft* and where there is a continuous airflow upward to the outside.
> 2. In penetrations tested in accordance with ASTM E119 listed in *Appendix A* as a part of the fireresistance rated assembly.
> 3. In penetrations of walls with a required one-hour fireresistance rating or less by a ducted HVAC system in areas of other than Use Group H where the building is equipped throughout with an *automatic sprinkler*

system in accordance with 780 CMR 906.2.1.

4. In garage exhaust or supply *shafts* which are separated from all other building *shafts* by not less than a two-hour fireresistance rated *fire separation assembly*.

709.6.5 Single membrane penetrations: Openings to accommodate noncombustible conduits, pipes and tubes through a single membrane that is an integral component of a fireresistance rated wall assembly shall be permitted provided that the aggregate area of all such openings does not exceed 100 square inches (64516 mm^2) in any 100 square feet (9.3 m^2) of wall area and the openings are *firestopped* with approved noncombustible materials.

709.7 Annular space protection: Where permitted by 780 CMR 709.6.1 for noncombustible penetrating items, the annular space between the penetrating item and the fireresistance rated assembly being penetrated shall be protected as specified in 780 CMR 709.7.1 through 709.7.3.

709.7.1 Materials: The material used to fill the annular space shall comply with 780 CMR 709.7.1.1 or 709.7.1.2.

709.7.1.1 Concrete or masonry assemblies: Penetrations of concrete or masonry assemblies by a maximum six-inch nominal diameter copper, iron or steel pipe, tube, conduit or wires and cables with steel jackets shall be permitted provided that the maximum opening size is 144 square inches (0.09 m^2) and the penetration is protected with concrete, grout or mortar for the full thickness of the assembly or the thickness required to provide a fireresistance rating equivalent to the required fireresistance rating of the assembly penetrated.

709.7.1.2 All assemblies: In all assemblies, the material shall prevent the passage of flame and hot gases sufficient to ignite cotton waste when subjected to the time-temperature fire conditions of ASTM E119 listed in ***Appendix A*** under a minimum positive pressure differential of 0.01 inch of water column (2.5 P) at the location of the penetration for the time period equivalent to the required fireresistance rating of the assembly penetrated.

709.7.2 Sleeves: Where sleeves are installed, the sleeves shall be noncombustible and shall be securely fastened to the assembly penetrated. All space between the item contained in the sleeve and the sleeve itself and any space between the sleeve and the assembly penetrated shall be filled with a material that complies with 780 CMR 709.7.1.

709.7.3 Insulation: Insulation and coverings on the penetrating item shall not pass through the assembly unless these materials maintain the required fireresistance rating of the assembly in accordance with 780 CMR 709.6.2.

780 CMR 710.0 VERTICAL SHAFTS

710.1 General: The provisions of 780 CMR 710.0 shall apply to all vertical *shafts* where such *shafts* are required to protect openings and penetrations through floor/ceiling and roof/ceiling assemblies as required by 780 CMR 713.3 and 713.4.

710.2 Construction: The *shaft* and the *shaft* enclosure shall be constructed of materials permitted by 780 CMR 602.0 for the type of construction of the building. *Shaft* walls which are exterior walls shall be constructed of materials approved for exterior walls in accordance with 780 CMR 14.

710.3 Fireresistance rating: A *shaft* shall be enclosed with *fire separation assemblies* complying with 780 CMR 709.0 having a fireresistance rating of not less than two hours where a *shaft* connects four stories or more and one hour where connecting less than four stories. A *shaft* enclosure shall have a fireresistance rating of not less than the required rating of the floor assembly penetrated but shall not be required to exceed two hours.

Exception: The fireresistance rating of interior *stairway* enclosures shall comply with 780 CMR 1014.11.

710.3.1 Openings in shaft enclosures: Openings other than those necessary for the purpose of the *shaft* shall not be permitted in *shaft* enclosures. Openings in *shaft* enclosures shall be protected with approved opening protectives in accordance with 780 CMR 706.0, 716.0, 717.0 and 718.0.

710.4 Top enclosure: A *shaft* that does not extend to the underside of the roof deck of the building shall be enclosed at the top with a *fire separation assembly* having a fireresistance rating of not less than that required for the *shaft* enclosure walls.

710.5 Bottom enclosure: *Shafts* which do not extend to the bottom of the building shall be enclosed at the lowest level with a *fire separation assembly* having a fireresistance rating of not less than that required for the *shaft* enclosure walls, or shall terminate in a room having an occupancy related to the purpose of the *shaft*. The room shall be separated from the remainder of the building by *fire separation assemblies* having a fireresistance rating with opening protectives of not less than that required for the *shaft* enclosure.

Exceptions:

1. The fireresistance rated room separation is not required provided that there are not any openings in or penetrations through the *shaft* enclosure to the remainder of the building except at the bottom. The bottom of the *shaft* shall be closed off around the penetrating items with materials permitted by 780 CMR 720.3 for *draftstopping*, or the room shall be equipped throughout with an *automatic sprinkler system* installed in accordance with 780 CMR 9.
2. The fireresistance rated room separation and *protection* at the bottom of the *shaft* are not required where there are not any combustible materials in the *shaft* and where there are not any openings in or other penetrations through the *shaft* enclosure to the remainder of the building.

780 CMR 711.0 FIRE PARTITIONS

711.1 General: *Fire partitions* shall be constructed of the types of materials and have the minimum fireresistance rating as prescribed by Table 602 for the type of construction.

> **Exception**: *Dwelling unit* separations in buildings of Types 2C, 3B and 5B construction shall have fireresistance ratings of not less than ½ hour in buildings equipped throughout with an *automatic sprinkler system* in accordance with 780 CMR 906.2.1 or 780 CMR 906.2.2, provided that *sprinklers* are installed in all closets located against tenant separation walls and in all bathrooms.

711.2 Corridor walls and tenant and dwelling unit separations: Wall assemblies that are installed as required by Table 602 for *corridor* walls, to separate tenant spaces and to separate *dwelling units*, shall be *fire partitions*.

711.3 Protectives: All opening protectives in *fire partitions* shall comply with the provisions of 780 CMR 704.0 and shall have the minimum fireresistance rating as set forth in 780 CMR 716.0.

711.4 Continuity: All *fire partitions* shall extend from the top of the floor assembly below to the underside of the floor/roof slab or deck above or to the fireresistance rated floor/ceiling or roof/ceiling assembly above, and shall be securely attached thereto. The supporting construction shall be protected to afford the required fireresistance rating of the wall supported, except for *exit access corridor* walls in buildings of Types 2C, 3B and 5B construction and tenant separation walls in covered mall buildings of Type 2C construction. All hollow vertical spaces shall be *firestopped* at every floor level as required in 780 CMR 720.0.

711.5 Exterior walls: Where exterior walls serve as a part of a required fireresistance rated enclosure, such walls shall comply with the requirements of 780 CMR 705.0 for exterior walls and the fireresistance rated enclosure requirements shall not apply.

711.6 Penetrations: Penetrations through assemblies shall comply with 780 CMR 709.6 through 780 CMR 709.7.3.

> **Exception**: In occupancies in other than Use Group H, *fire dampers* are not required:
>
> 1. At penetrations of tenant separation and *corridor* walls in buildings equipped throughout with an *automatic sprinkler system* in accordance with 780 CMR 906.2.1.
> 2. At penetrations of *corridor* walls where the ducts are constructed of steel and do not have openings which communicate the *corridor* with adjacent spaces or rooms.

780 CMR 712.0 SMOKE BARRIERS

712.1 Where required: Smoke barriers shall be provided as required in 780 CMR 409.4 for occupancies in Use Group I-2 and 780 CMR 410.6 for occupancies in Use Group I-3.

712.2 Construction: Smoke barriers shall have a fireresistance rating of not less than one hour. Such barriers shall form an effective membrane continuous from outside wall to outside wall and from floor slab to floor or roof deck above, including continuity through all concealed spaces, such as the space above suspended ceilings, and including interstitial structural and mechanical spaces. Transfer grilles, whether equipped with fusible link-operated dampers or not, shall not be installed in these partitions. The supporting construction shall be protected to afford the required fireresistance rating of the wall supported in buildings of other than Types 2C, 3B and 5B construction.

> **Exceptions**:
>
> 1. Smoke barriers are not required in interstitial spaces where such spaces are designed and constructed with ceilings that provide resistance to the passage of fire and smoke equivalent to that provided by the smoke barriers.
> 2. Smoke barriers in occupancies in Use Group I-3 are permitted to be constructed of nominal 0.10-inch-thick steel plate.

712.3 Doors: Doorways separating *corridors* in adjoining *smoke compartments* shall be equipped with a pair of swinging-type doors, each swinging in a direction opposite from the other, and the minimum width of each door leaf shall be 44 inches (1118 mm) for *corridors* utilized for the movement of beds and 34 inches (864 mm) for other *corridors*. Other doors in smoke barriers shall be of the swinging type of required width.

Exceptions:

1. Horizontal sliding doors that comply with 780 CMR 410.0 are permitted in smoke barriers in occupancies in Use Group I-3.
2. Horizontal sliding doors that comply with 780 CMR 1017.4.4.

712.4 Opening protectives: Doors in smoke barriers shall have a *fire protection rating* of not less than 20 minutes in accordance with 780 CMR 716.0. Double *means of egress corridor* doors shall have vision panels of ¼-inch-thick *labeled* wired glass mounted in approved steel frames in accordance with 780 CMR 716.0. The doors shall close the openings with only the clearance necessary for proper operation under self-closing or automatic-closing operations and shall be without undercuts, louvers or grilles. Rabbets or astragals are required at the meeting edges of double *means of egress* doors, and stops are required on the head and jambs of all doors in smoke barriers. Positive latching devices are required on double *means of egress corridor* doors.

Exceptions:

1. In occupancies in Use Group I-2, double *means of egress* cross-*corridor* doors shall be 1¾-inch solid core wood or steel doors. Positive latching devices are not required on double *means of egress* cross-*corridor* doors, and center mullions are prohibited.
2. Security glazing protected on both sides by an *automatic sprinkler system* shall be permitted in doors and windows in smoke barriers in occupancies in Use Group I-3. Individual panels of glazing shall not exceed 1,296 square inches (0.84 m^2), shall be in a gasketed frame and installed in such a manner that the framing system will deflect without breaking (loading) glazing before the *sprinkler* system operates. The *sprinkler* system shall be designed to wet completely the entire surface of the affected glazing when actuated.

712.4.1 Door closers: Doors in smoke barriers shall be provided with approved door hold-open devices of the failsafe type which shall release the doors, causing them to close upon the actuation of smoke detectors as well as upon the application of a maximum manual pull of 50 pounds (244 N) against the hold-open device.

Exception: Doors in smoke barriers in occupancies in Use Group I-3 shall be self-closing or automatic-closing by smoke detection.

712.5 Smoke damper: An approved damper designed to resist the passage of smoke shall be provided at each point a duct penetrates a smoke barrier. The damper shall close upon detection of smoke by an approved smoke detector located within the duct.

Exceptions:

1. In lieu of an approved smoke detector located within the duct, ducts that penetrate smoke barriers above smoke barrier doors that are required by 780 CMR 712.4 shall have the approved damper arranged to close upon detection of smoke by the local device designed to detect smoke on either side of the smoke barrier door opening.
2. Dampers at the smoke barrier in a fully ducted system are not required.

780 CMR 713.0 FLOOR/CEILING AND ROOF/CEILING ASSEMBLIES

713.1 General: All floor and roof assemblies shall comply with the applicable provisions of 780 CMR and shall have a fireresistance rating of not less than the fireresistance rating required in 780 CMR 602.0.

Exception: *Dwelling unit* separations in buildings of Types 2C, 3B and 5B construction shall have fireresistance ratings of not less than ½ hour in buildings equipped throughout with an *automatic sprinkler system* in accordance with 780 CMR 906.2.1 or 780 CMR 906.2.2, provided that *sprinklers* are installed in all closets located against tenant separation walls and in all bathrooms.

713.1.1 Ceiling panels: Where the weight of lay-in ceiling panels, used as part of fireresistance rated floor/ceiling or roof/ceiling assemblies, is not adequate to resist an upward force of 1 psf (5 kg/m^2), wire or other approved devices shall be installed above the panels to prevent vertical displacement under such upward force.

713.1.2 Unusable space: In an assembly required to have a one-hour fireresistance rating, the ceiling membrane of a fireresistance rated assembly is not required to be installed where unusable space occurs below the assembly, or the flooring is not required to be installed where unusable space occurs above the assembly.

713.2 Continuity: All floor/ceiling and roof/ceiling assemblies shall be continuous without openings or penetrations except as permitted by 780 CMR 713.0. Floor assemblies which are required to be fireresistance rated shall extend to and be tight against exterior walls, or other provisions shall be made for maintaining the fireresistance rating of the assembly at such locations. Penetrations through a roof deck to the outside are permitted provided that the required fireresistance rating of the roof construction is maintained. All concealed spaces and openings shall be *firestopped* and *draftstopped* in accordance with 780 CMR 720.0.

713.3 Floor opening enclosure: All floor openings connecting two or more stories shall be protected by a *shaft* enclosure that complies with 780 CMR 710.0.

Exceptions: A *shaft* enclosure is not required for any of the following floor openings:

1. A floor opening serving and contained within a single *dwelling unit* and connecting four stories or less.
2. A floor opening which:
   2.1. Is not part of the required *means of egress*;
   2.2. Is not concealed within the building construction;
   2.3. Does not connect more than two stories;
   2.4. Is separated from other floor openings serving other floors by construction conforming to 780 CMR 710.3; and
   2.5. Is not open to a *corridor* in occupancies in Use Groups I and R, or is not open to a *corridor* on a floor not equipped throughout with an approved *automatic fire suppression system* in other use groups.
3. A floor opening in a mall that complies with 780 CMR 402.0.
4. A floor opening between a *mezzanine* that complies with 780 CMR 505.0, and the floor below.
5. An atrium that complies with 780 CMR 404.0.
6. A floor opening in an open parking structure that complies with 780 CMR 406.0.
7. An approved masonry chimney where annular space protection is provided for in accordance with 780 CMR 720.6.4.
8. A *shaft* enclosure for an *escalator* floor opening is not required where a *shaft* enclosure is not required for floor openings in accordance with 780 CMR 713.3 or where the building is equipped throughout with an *automatic sprinkler system* in accordance with 780 CMR 906.2.1 and the *escalator* opening is protected in accordance with 780 CMR 713.4.3.4 or 713.4.3.5.
9. A floor opening that complies with 780 CMR 410.5 in an occupancy in Use Group I-3.
10. Noncombustible *shafts* connecting communicating floor levels in an occupancy in Use Group I-3 where the area complies with 780 CMR 410.5. Where additional stories are located above or below, the *shaft* shall be permitted to continue with fire and smoke damper protection provided at the fireresistance rated floor/ceiling assembly between the noncommunicating stories.
11. A single floor opening containing a *stairway* which is not a required *means of egress* in an occupancy in Use Group B and complying with the following parameters:
    11.1. The *stairway* does not connect more than six floor levels.
    11.2. The *stairway* does not connect with an *exit access corridor*.
    11.3. The *stairway* floor opening shall not exceed 160 square feet (15 m^2).
    11.4. The *stairway* floor opening shall be protected in the same manner as an *escalator* floor opening complying with 780 CMR 713.3 Exception 8, and 524 CMR.
    11.5. The building is equipped throughout with an approved *automatic sprinkler system* in accordance with 780 CMR 906.2.1.

713.4 Penetration protection: All penetrations of a floor/ceiling assembly or the ceiling membrane of a roof/ceiling assembly shall be protected by a *shaft* enclosure that complies with 780 CMR 710.0.

Exceptions:

1. Penetrations within and through a floor opening permitted to be unenclosed by 780 CMR 713.3.
2. Penetrations through assemblies required to be fireresistance rated and complying with 780 CMR 713.4.1 or 780 CMR 713.4.2.
3. Penetrations through assemblies without a required fireresistance rating and complying with 780 CMR 713.4.1 or 780 CMR 713.4.3.

713.4.1 Through-penetration system: A *shaft* enclosure shall not be required where cables, cable trays, conduits, tubes or pipes penetrate a floor assembly and are protected with an approved *through-penetration protection system* tested in accordance with ASTM E814 listed in *Appendix A*. The positive pressure differential between the exposed and unexposed surfaces of the test assembly shall not be less than 0.01-inch water gage (2.5 P). The system shall have an "F" rating and a "T" rating of not less than 1 hour but not less than the required fireresistance rating of the assembly being penetrated. All penetrations through a ceiling that is an integral component of a fireresistance rated floor/ceiling or roof/ceiling assembly, shall comply with 780 CMR 713.4.2.

Exceptions:

1. A "T" rating shall not be required for floor penetrations that are contained and located within the cavity of a wall.
2. A "T" rating shall not be required for floor penetrations by pipe, tube and conduit that are not in direct contact with combustible material.

713.4.2 Fireresistance rated assemblies: The required fireresistance rating of floor/ceiling and roof/ceiling assemblies shall be determined in accordance with ASTM E119 listed in *Appendix A*. Except where permitted by 780 CMR 713.4.2.1 through 713.4.2.3, penetrations for electrical, mechanical, plumbing and communication conduits, pipes and systems shall be installed in accordance with the approved ASTM E119 rated assembly. In the case of ceilings that are an integral component of a fireresistance rated floor/ceiling or roof/ceiling assembly, all penetrations shall be installed in accordance with the approved ASTM E119 rated assembly or 780 CMR 713.4.2.3.

Exceptions:

1. Outlet boxes and fittings are permitted, provided that such devices are listed for installation in fireresistance rated assemblies and are installed in accordance with the listing.
2. Ceiling dampers shall not be required where fire tests have shown that such dampers are not necessary in order to maintain the fireresistance rating of the assembly.

713.4.2.1 Noncombustible penetrations: Penetrations by noncombustible vents, chimneys, conduits, pipes and tubes through a fireresistance rated floor assembly which connect not more than two stories are permitted. Penetrations by noncombustible conduit, pipe and tubes through a fireresistance rated floor assembly which connect more than two stories are permitted provided that the aggregate area of the penetrating items shall not exceed one square foot (0.09 m^2) in any 100 square feet (9.3 m^2) of floor area. In all cases, the annular space between the penetrating item and the assembly shall be protected in accordance with 780 CMR 707.8.

713.4.2.2 Air ducts: Penetrations by an air duct or plenum through a fireresistance rated floor assembly, which connect not more than two stories, are permitted where a *fire damper* that complies with 780 CMR 717.0 is installed at the floor line. A *fire damper* is not required at penetrations of a roof/ceiling assembly where ducts are open to the atmosphere.

713.4.2.3 Ceiling penetrations: In the case of ceilings that are an integral component of a fireresistance rated floor/ceiling or roof/ceiling assembly, openings to accommodate noncombustible conduits, pipes, tubes, electrical outlets or air ducts shall be permitted provided that the aggregate area of such openings does not exceed 100 square inches (0.065 m^2) in any 100 square feet (9.3 m^2) of ceiling area. The space around noncombustible conduits, pipes, tubes and electrical outlet boxes at the ceiling penetration shall be *firestopped* in accordance with 780 CMR 720.6.4 or shall be protected in accordance with 780 CMR 709.7 or 780 CMR 713.4.1. For noncombustible air duct penetrations, an approved ceiling damper shall be installed at the ceiling line. Ceiling dampers shall be constructed in accordance with the details listed in a fireresistance rated design or shall be *labeled* to function as a heat barrier for air-handling outlet/inlet penetrations in the ceiling of a fireresistance rated assembly.

713.4.3 Nonfireresistance rated assemblies: Penetrations of floor assemblies without a required fireresistance rating shall conform to 780 CMR 713.4.3.1 through 713.4.3.3. All penetrations through the ceiling membrane of a roof assembly without a required fireresistance rating shall be protected in accordance with 780 CMR 720.6.4.

713.4.3.1 Noncombustible penetrations: Penetrations by noncombustible vents, chimneys, conduits, pipes and tubes through unprotected floor assemblies which connect not more than three stories are permitted provided that the annular space between the penetrating item and the floor is protected in accordance with 780 CMR 720.6.4.

713.4.3.2 Air ducts: Penetrations by noncombustible air ducts through unprotected floor assemblies which connect not more than three stories are permitted provided that a *fire damper* complying with 780 CMR 717.0 is installed at each floor line.

713.4.3.3 Noncombustible or combustible penetrations: Penetrations by vents, chimneys, cables, wires, air ducts, conduits, pipes and tubes through an unprotected floor assembly which connect not more than two stories are permitted provided that the annular space is protected in accordance with 780 CMR 720.6.4.

713.4.3.4 Escalators/automatic fire shutter: *Escalators* shall be equipped with a power-operated automatic shutter at every floor pierced thereby, constructed of approved noncombustible materials with a fire protection rating of not less than 1½ hours. The shutter shall close immediately upon the automatic detection of fire and smoke by an approved device and shall completely shut off the well opening. The shutter shall operate at a speed of not more than 30 feet per minute (0.15 m/s) and shall be equipped with a sensitive leading edge to arrest the shutter's progress when in contact with any obstacle, and to continue the shutter's progress on release therefrom. Refer to 780 CMR 713.3, Exception 8.

713.4.3.5 Escalators/water curtain: The area of the floor opening shall not exceed twice the horizontal projected area of the *escalator* and the opening shall not connect more than four stories in occupancies in other that Use Groups B and M and the opening shall be protected by a draft curtain and a closed *sprinkler* water curtain conforming to NFiPA 13 listed in ***Appendix A***. Refer to 780 CMR 713.3, Exception 8

780 CMR 714.0 ROOF CONSTRUCTION

714.1 General: Roofs shall be constructed of materials or assemblies of materials designed to afford the fireresistance rating required by Table 602 as herein modified.

714.2 Stadiums: The roof construction, including beams, trusses, framing, arches and roof decks, enclosing stadiums of Type 1 or Type 2 construction, shall be of approved noncombustible materials without a specified fireresistance rating or of Type 4 construction.

714.3 Roofs 20 feet or higher: Where every part of the structural framework of roofs in buildings of Type 1 or Type 2 construction is 20 feet (6096 mm) or more above the floor immediately below, omission of all fire *protection* of the structural members is permitted, including the *protection* of trusses, roof framing and decking.

714.4 Roof slabs, arches and decking: Where the omission of fire *protection* from roof trusses, roof framing and decking is permitted, roofs in buildings of Types 1 and 2 construction shall be constructed of noncombustible materials, or of fireretardant- treated wood as permitted in Table 602, without a specified fireresistance rating, or of Type 4 construction in

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buildings not over five stories or 65 feet (19812 mm) in *height*.

714.5 Firestopping: *Firestopping* of ceiling and *attic* spaces shall be provided as required by 780 CMR 720.0.

780 CMR 715.0 FIRERESISTANCE RATING OF STRUCTURAL MEMBERS

715.1 Requirements: The fireresistance rating of structural members and assemblies shall comply with the requirements for the type of construction and shall not be less than the rating required for the fireresistance rated assemblies supported, except as provided for in 780 CMR 711.4 for support of *exit access corridor* walls and tenant separation walls in covered mall buildings, and in 780 CMR 712.2 for support of smoke barriers. The maximum required fireresistance rating of structural members supporting *fire separation assemblies* of tank storage areas as provided for in 780 CMR 418.3.2.1 shall be two hours, but not less than required by Table 602 for the building construction type.

715.2 Protection of structural members: Columns, girders, trusses, beams, lintels or other structural members which are required to have a fireresistance rating and which support more than two floors or one floor and roof, or support a loadbearing wall or a nonloadbearing wall more than two stories high, shall be individually *protected* on all sides for the full length or *height* with materials having the required fireresistance rating. All other structural members required to have a fireresistance rating shall be *protected* by individual encasement, by a membrane or ceiling protection as specified in 780 CMR 713.0, or by a combination of both.

715.3 Embedments and enclosures: Pipes, wires, conduits, ducts or other service facilities shall not be embedded in the required fire protective covering of a structural member that is required to be individually encased.

715.4 Impact protection: Where the fire protective covering of a structural member is subject to impact damage from moving vehicles, the handling of merchandise or other activity, the fire protective covering shall be protected by corner guards or by a substantial jacket of metal or other noncombustible material to a height adequate to provide full protection, but not less than five feet (1524 mm) from the finished floor.

715.5 Exterior structural members: Structural members located in exterior walls or along the outer lines of a building or structure shall be *protected* as required by Table 602 for exterior loadbearing walls for the type of construction involved and shall be protected against corrosion in accordance with 780 CMR 2210.1. The interior faces of exterior structural members shall be *protected* with coverings of not less than the required fireresistance rating specified for interior structural members in Table 602. Where a fireresistance rating is required in Table 602 for exterior loadbearing walls in buildings of Types 2C, 3B and 5B construction, the interior faces of any exterior structural member of such buildings shall be *protected* to provide a fireresistance rating not less than that required for exterior load- bearing walls.

715.6 Bottom flange protection: Fire protection is not required for the bottom flange of lintels, shelf angles and plates which are not a part of the structural frame or which have a span of six feet (1829 mm) or less.

715.7 Stone lintels: Stone lintels on spans exceeding four feet (1219 mm) shall not be permitted, unless supplemented by fireresistance rated structural members or masonry arches of the required strength to support the superimposed *loads*.

780 CMR 716.0 FIRE DOOR ASSEMBLIES

716.1 Fire door assemblies: Approved *fire door* assemblies as defined in 780 CMR shall be constructed of any material or assembly of component materials which conforms to the test requirements of ASTM E152 listed in ***Appendix A*** and the *fire protection rating* herein required in Table 716.1, unless otherwise specifically provided for in 780 CMR.

716.1.1 Twenty-minute doors: *Fire doors* having a *fire protection rating* of 20 minutes shall be tested in accordance with ASTM E152 listed in ***Appendix A*** without the hose stream test.

716.1.2 Doors in exit enclosures: All doorway opening protectives for *exit* enclosures shall be *labeled means of egress fire doors* and shall have a maximum transmitted temperature end point of not more than 450°F (232°C) above ambient at the end of 30 minutes of standard fire test exposure.

Table 716.1
OPENING PROTECTIVE FIRE PROTECTION RATING

Type of assembly	Required assembly rating (hour)	Minimum opening protection assembly (hour)
Fire walls and fire separation assemblies having a required fireresistance rating greater than one hour	4	3
	3	3
	2	1½
	1½	1½
Fire separation assemblies:		
Shaft and exit enclosure walls	1	1
Other fire aeparation assemblies	1	¾
Fire partitions:		
Exit access corridor enclosure wall	1	⅓[a]
	½	⅓[a]
Other fire partitions	1	¾

Note a. For testing requirements, see 780 CMR 716.1.1.

716.2 Labeled protective assemblies: All *fire door* assemblies shall be *labeled* by an *approved agency*. *Labeled* protective assemblies that conform to the requirements of 780 CMR 716.0 or UL 10A, 14B and 14C for tin-clad *fire door* assemblies, and NFiPA 80 listed in ***Appendix A***, shall be approved for use as provided for in 780 CMR.

716.2.1 Labeling requirements: *Fire doors* shall have a *label* or other identification showing the name of the manufacturer, the *fire protection rating* and, where required for *fire doors* in *exit* enclosures by 780 CMRs 716.1.2 or 1014.8.3, the maximum transmitted temperature end point. Such *label* shall be approved and shall be permanently affixed. The *label* shall be applied at the factory where fabrication and assembly are done. Inspection shall be made by an *approved agency*.

716.2.2 Oversized doors: Approval of doors which cannot be *labeled* because of size shall be based on a certificate of inspection furnished by an *approved testing agency* for such oversized doors. The certificate shall state that the door conforms to the requirements of design, materials and construction, but has not been subjected to the fire test.

716.3 Multiple doors in fire walls: Two doors, each with a *fire protection rating* of 1½ hours, installed on opposite sides of the same opening in a *fire wall*, shall be deemed equivalent in *fire protection rating* to one three-hour *fire door*.

716.4 Glass panels: Wired glass panels shall be permitted in *fire doors* within the limitations of 780 CMR 719.0 and as herein specifically prescribed.

716.5 Door closing: *Fire doors* shall be self-closing or automatic-closing in accordance with the requirements of NFiPA 80 listed in ***Appendix A*** and the requirements of 780 CMR 716.5.1 through 716.5.4.

716.5.1 Smoke-activated doors: *Fire doors* which are not self-closing and which protect openings in *horizontal exits*, *exits* or *exit access corridors* required to be of fireresistance rated construction shall be automatic-closing by the actuation of smoke detectors or by loss of power to the smoke detector or the hold-open device.

716.5.2 Doors in pedestrian ways: Vertical sliding or vertical rolling steel *fire doors* in openings through which pedestrians travel shall not be automatic-closing by actuation of smoke detectors.

Exception: Doors that are activated by smoke detectors arranged on an *alarm verification* circuit in accordance with 780 CMR 918.7.

716.5.3 Swinging fire doors: The door closers for swinging *fire doors* that are not required to be automatic-closing by smoke detector activation in accordance with 780 CMR 716.5.1, shall be permitted to be activated by a single fusible link incorporated in the hold-open arm of an approved door closer where the ceiling is less than three feet (914 mm) above each side of the door opening.

716.5.4 Closing time: Doors that are automatic-closing by *automatic fire detectors* or are self-closing shall not have a delay in the initiation of closing or reclosing of more than ten seconds.

780 CMR 717.0 FIRE DAMPERS

717.1 Approval: *Fire dampers* shall comply with the requirements of UL 555 listed in ***Appendix A*** and shall bear the *label* of an *approved testing agency*. *Fire dampers* shall be classified and identified in accordance with UL 555. *Fire dampers* installed in systems that continue to operate when smoke or heat from a fire is detected shall be *labeled* for installation in dynamic systems as required by UL 555. *Fire dampers* shall be installed in accordance with manufacturer's installation instructions. *Fire dampers* shall have the minimum *fire protection rating* specified in Table 717.1 for the type of penetration.

Table 717.1
FIRE DAMPER RATING

Type of Penetration	Minimum damper rating (hour)
Fire partitions less than 1 hour	½
Unprotected floor assemblies (see 780 CMR 713.4.3.2)	
Single membrane of a 1-hour fireresistance rated assembly	
1-hour fireresistance rated assemblies	1
2-hour fireresistance rated assemblies	1½
3-hour or greater fireresistance rated assemblies	3

717.2 Where required: *Fire dampers* shall be provided at locations required by 780 CMR where air distribution system penetrate assemblies required to have a fireresistance rating. Where the installation of a *fire damper* will interfere with the operation of a required smoke control system in accordance with 780 CMR 921.0 or the operation of an exhaust system conveying *hazardous materials* as defined in the mechanical code listed in *Appendix A*, approved alternative protection shall be utilized.

717.3 Access: Access shall be provided to *fire dampers* for inspection and servicing.

780 CMR 718.0 FIRE WINDOWS AND SHUTTERS

718.1 Fireresistance rating: Approved assemblies of *fire windows* and fire shutters shall meet the test requirements of ASTM E163 listed in *Appendix A*. *Fire windows* shall be in the fixed closed position or be automatic-closing.

718.1.1 Exception: Steel window frame assemblies of ⅛-inch (3 mm) minimum solid section or of not less than nominal 0.048-inch-thick formed sheet steel members *fabricated* by pressing, mitering, riveting, interlocking or welding and having provision for glazing with ¼-inch wired glass as required in 780 CMR 719.0 where securely installed in the building construction and glazed with ¼-inch *labeled* wired glass, shall be deemed to meet the requirements for a ¾-hour *fire window* assembly.

718.2 Window mullions: All metal mullions which exceed a nominal height of 12 feet shall be protected with materials to afford the same fireresistance rating as required for the wall construction in which the protective is located.

718.3 Swinging fire shutters: Where fire shutters of the swinging type are installed in exterior openings, not less than one row in every three vertical rows shall be arranged to be readily opened from the outside, and shall be identified by distinguishing marks or letters not less than six inches (152 mm) high.

718.4 Rolling fire shutters: Where fire shutters of the rolling type are installed, such shutters shall be of approved counter-balanced construction and capable of being readily opened from the outside.

780 CMR 719.0 WIRED GLASS

719.1 General: Wired glass installed as an opening protective shall be tested in accordance with ASTM E163 listed in *Appendix A*, shall bear the *label* of an *approved agency* and shall be installed in approved frames. Wired glass panels shall conform to the size limitations set forth in Table 719.1.

Table 719.1
LIMITING SIZE[a] OF WIRED GLASS PANELS

Opening fire protection rating	Maximum area (square inches)	Maximum height (inches)	Maximum width (inches)
3 hour	0	0	0
1½-hour doors in exterior walls	0	0	0
1 and 1½ hours	100	33	10
¾ hour	1,296	54	54
⅓ hour	not limited	not limited	not limited
Fire windows	1,296	54	54

Note a. 1 Inch = 25.4 mm: 1 square inch = 0.0006452 m^2.

719.1.1 Fire walls: Wired glass in *fire doors* located in *fire walls* shall be prohibited except that where serving as a *horizontal exit*, a self-closing swinging door shall be permitted to have a vision panel of not more than 100 square inches (0.065 m^2) without a dimension exceeding ten inches (254 mm).

719.1.2 Fire separation assemblies: Wired glass vision panels shall not be installed in *fire doors* having a 1½-hour *fire protection rating* intended for installation in *fire separation assemblies*, unless the glass panels are not more than 100 square inches (0.065 m^2) in area.

719.2 Exit and elevator protectives: Except where *fire doors* are specifically required by 780 CMR 4 to be solid in such locations where unusually hazardous conditions prevail, approved wired glass vision panels used in *fire doors* in elevator and *stairway shaft* enclosures shall be so located as to furnish clear vision of the passageway or approach to the elevator or *stairway* and shall not exceed the size limitations specified in Table 719.1.

719.3 Fire separation assemblies: Panels of ¼-inch wired glass shall not be installed in *fire separation assemblies* intended for subdividing purposes as set forth in 780 CMR 709.1 where the required fireresistance rating of the wall exceeds one hour.

The maximum size of such panels shall not exceed the limitations for a ¾-hour door.

780 CMR 720.0 FIRESTOPPING AND DRAFTSTOPPING

720.1 General: To prevent the free passage of flame and products of combustion through concealed spaces or openings in the event of fire, provisions shall be made to provide effective *firestops* or *draftstops* as herein specified.

720.2 Firestopping materials: All *firestopping* shall consist of approved noncombustible materials securely fastened in place. *Firestops* of approved noncombustible materials or of materials of two thicknesses of one-inch lumber with broken lap-joint, or one thickness of 23/32-inch wood structural panel with joints backed by 23/32-inch wood structural panel, or of two-inch lumber installed with tight joints, shall be installed in open spaces of wood framing.

720.3 Draftstopping materials: *Draftstopping* materials shall not be less than ½ -inch gypsum board, ⅜-inch plywood or other approved materials adequately supported.

720.4 Integrity: The integrity of all *firestopping* and *draftstopping* shall be continuously maintained.

720.5 Required inspection: *Firestopping* and *draftstopping* shall not be concealed from view until inspected and approved.

720.6 Firestopping required: *Firestopping* shall be installed in the locations specified in 780 CMR 720.6.1 through 720.6.7.

720.6.1 Concealed wall spaces: *Firestopping* shall be installed in concealed spaces of stud walls and partitions, including furred or studded-off spaces of masonry or concrete walls, and at the ceiling and floor or roof levels. *Firestopping* is not required at the ceiling level of walls, partitions and furred spaces constructed of noncombustible materials as defined by 780 CMR 704.4.

720.6.2 Connections between horizontal and vertical spaces: *Firestopping* shall be installed at all interconnections between vertical and horizontal spaces such as occur at soffits over cabinets, drop ceilings, cove ceilings and similar locations.

720.6.3 Stairways: *Firestopping* shall be installed in concealed spaces between stairway stringers at the top and bottom of the run.

720.6.4 Ceiling and floor openings: Where permitted by Exception 7 of 780 CMR 713.3, or by 780 CMR 713.4.2.3 or 713.4.3, *firestopping* shall be installed at openings around vents, pipes, ducts, chimneys and fireplaces at ceiling and floor levels, with approved noncombustible materials. Factory built chimneys and fireplaces shall be *firestopped* in accordance with UL 103 and UL 127 listed in ***Appendix A***. Where ceilings or floors are required to be fireresistance rated, the openings around vents, pipes, ducts, chimneys and fireplaces shall be protected in accordance with the requirements of 780 CMR 713.4 through 713.4.2.3.

720.6.5 Architectural trim: *Firestopping* shall be installed in exterior cornices and other exterior architectural elements where permitted of combustible construction in 780 CMR 1406.0, or where erected with combustible frames, at maximum intervals of 20 feet (6096 mm). If noncontinuous, such elements shall have closed ends, with at least four inches (102 mm) of separation between sections.

720.6.6 Combustible finish and trim: *Firestopping* shall be installed in the space behind combustible trim and finish where permitted under 780 CMR and all other hollow spaces where permitted in fireresistance rated construction at ten-foot (3048 mm) intervals; or the space shall be solidly filled with approved noncombustible materials.

720.6.7 Concealed sleeper spaces: *Firestopping* shall be installed in concealed spaces formed by floor sleepers in areas of not more than 100 square feet (9.30 m^2); or the space shall be solidify filled with approved noncombustible materials.

720.7 Draftstopping required: *Draftstopping* shall be installed in buildings of Types 3, 4 and 5 construction in the locations specified by 780 CMR 720.7.1 and 720.7.2.

720.7.1 Floors: Where ceilings are suspended below solid wood joists or suspended or attached directly to the bottom of open-web wood floor trusses, the space between the ceiling and the floor above shall be divided by *draftstopping* as specified in 780 CMR 720.7.1.1 through 720.7.1.3.

720.7.1.1 Use Groups R-1 and R-2: In occupancies in Use Groups R-1 and R-2, *draftstopping* shall be installed in line with tenant and *dwelling unit* separation walls where the walls do not extend to the underside of the floor sheathing above.

Exception: *Draftstopping* is not required in buildings equipped throughout with an *automatic sprinkler system* installed in accordance with 780 CMR 906.2.1 or 906.2.2, provided that automatic *sprinklers* are also installed in the combustible concealed space.

720.7.1.2 Use Group R-3: In occupancies in Use Group R-3, the space shall be divided into approximately equal areas not greater than 500 square feet (46.5 m^2). The *draftstopping* shall be installed parallel to the main framing members.

Exception: *Draftstopping* is not required in buildings equipped throughout with an *automatic sprinkler system* installed in accordance with 780 CMR 906.2.1 or 906.2.2, provided that automatic *sprinklers* are also installed in the combustible concealed space.

720.7.1.3 Other use groups: In all other use groups, *draftstopping* shall be installed so that horizontal areas do not exceed 1,000 square feet (93 m^2).

Exception: *Draftstopping* is not required in buildings equipped throughout with an *automatic sprinkler system* installed in accordance with 780 CMR 906.2.1 or 906.2.2, provided that automatic *sprinklers* are also installed in the combustible concealed space above the ceiling.

720.7.2 Attics and concealed spaces: *Attics* and concealed roof spaces shall be provided with *draftstopping* as specified in 780 CMR 720 7.2.1 and 720.7.2.2.

720.7.2.1 Use Group R: In occupancies in Use Group R, in *attics*, mansards, overhangs or other concealed roof spaces, *draftstopping* shall be installed above, and in line with, tenant and *dwelling unit* separation walls that do not extend to the underside of the roof sheathing above.

Exceptions:

1. Where *corridor* walls provide a tenant or *dwelling unit* separation, *draftstopping* shall only be required above one of the *corridor* walls.
2. Flat roofs with solid joist construction are not required to be provided with *draftstopping* over tenant and *dwelling unit* separation walls if the joists form a *draftstop*.
3. *Draftstopping* is not required in buildings equipped throughout with an *automatic sprinkler system* installed in accordance with 780 CMR 906.2.1 or 906.2.2, provided that automatic *sprinklers* are also installed in *attics*, mansards, overhangs and other concealed roof spaces of combustible concealed space.
4. *Draftstopping* is not required in detached *one- and two-family dwellings*.
5. In occupancies in Use Group R-2 which do not exceed four stories in *height*, the *attic* space shall be subdivided by *draftstops* into areas not exceeding 3,000 square feet (279 m^2) or above every two *dwelling units*, whichever is smaller.

720.7.2.2 Other use groups: *Draftstopping* shall be installed in *attics* and concealed roof spaces, such that any horizontal area does not exceed 3,000 square feet (279 m^2).

Exceptions:

1. Flat roofs with solid joist construction are not required to be provided with *draftstopping* over tenant separation walls if the joists form a *draftstop*.
2. *Draftstopping* is not required in buildings equipped throughout with an *automatic sprinkler system* installed in accordance with 780 CMR 906.2.1 or 906.2.2, provided that automatic *sprinklers* are also installed in *attics* and other concealed roof spaces of combustion construction.

720.8 Ventilation: *Ventilation* of concealed roof spaces shall be maintained in accordance with 780 CMR 1210.0.

780 CMR 721.0 FIRERESISTIVE REQUIREMENTS FOR PLASTER

721.1 Thickness of plaster: The required thickness of fireresistance rated plaster protection shall be determined by the prescribed fire tests for the specified use group and type of construction and in accordance with the provisions of 780 CMR 2505.0 for interior plastering and 780 CMR 2506.0 for exterior plastering. The thickness in all cases shall be measured from the face of the lath where applied to gypsum lath or metal lath.

721.2 Plaster equivalents: For fireresistive purposes, ½ inch (13 mm) of unsanded gypsum plaster shall be deemed equivalent to ¾ inch (19 mm) of one-to-three sanded gypsum or one inch (25 mm) of Portland cement sand plaster.

721.3 Noncombustible furring: In buildings of Types 1 and 2 construction, plaster shall be applied directly on masonry or on approved noncombustible plastering base and furring.

721.4 Double reinforcement: Except in solid plaster partitions, or where otherwise determined by the prescribed fire tests, plaster protection more than one inch (25 mm) in thickness shall be reinforced with an additional layer of approved lath embedded at least ¾ inch (19 mm) from the outer surface and fixed securely in place.

721.5 Plaster alternatives for concrete: In reinforced concrete construction, gypsum or portland cement plaster is permitted to be substituted for ½ inch (13 mm) of the required poured concrete protection, except that a minimum thickness of ⅜ inch (ten mm) of poured concrete shall be provided in all reinforced concrete floors and one inch (25 mm) in reinforced concrete columns in addition to the plaster finish. The concrete base shall be prepared in accordance with 780 CMR 2506.0.

780 CMR 722.0 THERMAL- AND SOUND-INSULATING MATERIALS

722.1 General: Insulating batts, blankets, fills or similar types of materials—other than fiberboard and foam plastic insulation —including *vapor retarders* and breather papers or other coverings which are incorporated in construction elements, shall be installed as required by 780 CMR 722.0. Fiberboard insulation shall be installed as required by 780 CMR 2309.0, and foam plastic insulation shall be installed as required by 780 CMR 2603.0.

722.2 Exposed installations: Such materials, where exposed as installed in rooms or spaces, including *attics* and crawl spaces of buildings of any type construction, shall have a flame spread rating of 25 or less and a smoke-developed rating of 450 or less when tested in accordance with ASTM E84 listed in ***Appendix A***. Plenum installations shall comply with the requirements of 780 CMR 2805.0 and the mechanical code listed in ***Appendix A***.

722.3 Concealed installations: Insulating materials, where concealed as installed in buildings of any type of construction, shall have a flame spread rating of 75 or less and a smoke-developed rating of 450 or less when tested in accordance with ASTM E84 listed in ***Appendix A***.

722.3.1 Facings: All *vapor retarders*, whether integral or applied separately, shall be installed on the warm side of the building element, and shall have a permeance not exceeding one perm. Where insulation materials are installed in concealed spaces (such as wall, floor or ceiling cavities), *attics* or crawl spaces in buildings of Types 3, 4 and 5 construction, the flame spread and smoke-developed rating limitations do not apply to facings, provided that the facing is installed behind and in substantial contact with the unexposed surface of the ceiling, floor or wall finish.

722.4 Cellulosic insulation: Cellulosic insulation shall meet the requirements of CPSC 16 CFR, Parts 1209 and 1404, listed in ***Appendix A***.

CHAPTER 8

INTERIOR FINISHES

780 CMR 801.0 GENERAL

801.1 Scope: Interior finish and trim of buildings shall conform to the requirements of 780 CMR 8. Interior finish shall include all wall, ceiling and *floor finishes* and wainscoting and paneling or other finish applied structurally or for acoustical treatment, insulation, decoration or similar purposes.

801.2 Installation and classification: All materials which are required to restrict the spread of flame or to be flameresistant under the provisions of 780 CMR - including, but not limited to, interior finish materials, fireretardant-treated wood, tents and tarpaulins, and interior hangings and decorations shall meet the requirements for installation and classification as determined by the applicable test procedures listed in 780 CMR 8.

780 CMR 802.0 DEFINITIONS

802.1 General: The following words and terms shall, for the purposes of 780 CMR 8 and as used elsewhere in 780 CMR, have the meanings shown herein.

Flame spread: The propagation of flame over a surface.

Flame spread rating: The measurement of flame spread on the surface of materials or their assemblies as determined by the tests specified in 780 CMR (see 780 CMR 803.0).

Flameresistance: That property of materials or combinations of component materials which restricts the spread of flame as determined by the flameresistance tests specified in 780 CMR (also see 780 CMR 807.2).

Floor finish: The finish placed on top of the floor, slab or other structural floor element.

780 CMR 803.0 INTERIOR FINISH AND TRIM

803.1 Exposed construction: These requirements shall not be considered as requiring the installation of interior finish, but where construction or fire protection materials are exposed in the use groups specified in 780 CMR 803.4, the hazard from rate of flame spread of such exposed materials shall not be greater than that of the interior finish permitted for such occupancy.

803.1.1 Paper finish: The use of a surface finish of paper or of material that does not have a greater fire hazard than paper shall not be prohibited, provided that such finish does not exceed 1/28 inch (1 mm) in thickness and is applied directly to a noncombustible base or substrate that conforms to the requirements of 780 CMR 2310.0.

803.1.2 Type 4 construction: Exposed portions of structural members complying with the requirements for buildings of Type 4 construction in 780 CMR 605.0 and 2304.0, shall not be subject to interior finish regulations.

803.1.3 Window exception: Show windows in the first story of buildings are permitted to be constructed of any approved materials.

803.2 Classification: All materials used for interior finish and trim shall be classified in accordance with ASTM E84 listed in ***Appendix A***. The classifications of interior finishes referred to herein correspond to flame spread ratings determined by ASTM E84 listed in ***Appendix A*** as follows: Class I flame spread, 0 - 25; Class II flame spread, 26 - 75; Class III flame spread, 76 - 200.

803.3 Materials: Materials shall only be installed as interior finish and trim as specifically provided for in 780 CMR for the occupancy of the space in which the material is installed. Installation of any material for *floor finish*, interior finish and trim in a building of Type 1 or 2 construction within the scope permitted in 780 CMR 803.0 or in 780 CMR 806.0 shall not declassify the building with respect to the type of construction classification.

803.3.1 Foam plastics: Foam plastics shall not be installed as interior trim or finish except in compliance with 780 CMR 803.0 and 780 CMR 2603.0.

803.3.2 Smoke development: Interior wall and ceiling finish materials that have a smoke-developed rating greater than 450 when tested in accordance with ASTM E84 listed in ***Appendix A*** shall not be permitted.

803.4 Required flame spread rating: Interior finish of walls and ceilings shall have a flame spread rating not greater than that designated by the class prescribed for the various use groups listed in Table 803.4, when tested in accordance with 780 CMR 803.2.

803.4.1 Basements: In occupancies other than Use Group R-3, Class I or II interior finish shall be required in all *basements* or other underground spaces from which there is not direct exit to the outside of the building, if subject to occupancy for any purpose other than storage or service facilities.

803.4.2 Maximum flame spread: Interior finish materials with flame spread classifications greater than 200 shall not be installed in any room or space subject to human occupancy, except to such extent as specifically approved on the basis of a finding that such installation does not significantly increase the life hazard.

803.4.3 Rooms and enclosed spaces: Requirements for rooms or enclosed spaces are based upon spaces enclosed in partitions of the building or structure, and where a fireresistanceis required for the structural elements, the enclosing partitions shall extend from the floor to the ceiling. Partitions that do not comply with this shall be considered as enclosing spaces and rooms or spaces on both sides thereof shall be counted as one. In determining the applicable requirements for rooms or enclosed spaces, the specific occupancy thereof shall be the governing factor, regardless of the use group classification of the building or structure. Where an *automatic sprinkler system* installed in accordance with 780 CMR 906.2.1 or 906.2.2 is installed throughout a building, Class II or III interior finish shall be permitted where Class I or II materials, respectively, are required in Table 803.4.

Table 803.4
INTERIOR FINISH REQUIREMENTS[g]

Use Group	Required vertical exits and passage-ways[c]	Corridors providing exit access[i]	Rooms or enclosed spaces[a]
A-1. A-2, A-3	I	I[e]	II[b]
A-4, B, E, F, I-1,	I	II	III
R-1, R-2	I	II	III
H	I	II	III[f]
I-2	I[h]	I[h]	I[h]
I-3	I	I	III
M: walls	I	II	III
ceilings	I	II	II[d]
R-3	III	III	III
S	II	II	III

Note a. For requirements applicable to rooms and enclosed spaces, see 780 CMR 803.4.3.

Note b. Class III interior finish materials are permitted in places of assembly with a capacity of 300 persons or less.

Note c. Class III interior finish materials are permitted for wainscoting or paneling for not more than 1,000 square feet (93m^2) of applied surface area in the grade lobby where applied directly to a noncombustible base or over furring strips applied to a noncombustible base and firestopped as required by 780 CMR 804.0.

Note d. Class III interior finish materials are permitted in mercantile occupancies of 3,000 square feet (279m^2) or less gross area occupied for sales purposes on the street floor only (balcony permitted).

Note e. Lobby areas shall not be less than Class II.

Note f. Where building height is over two stories, Class II shall be required.

Note g. For the classifications of interior finishes referred to herein, see 780 CMR 803.2. For interior finish requirements for exposed insulation, see 780 CMR 722.2.

Note h. Walls and ceilings shall be a minimum of Class ll materials in individual rooms of not more than four persons in capacity Where a building is equipped throughout with an automatic sprinkler system installed in accordance with 780 CMR 906.2.1 the minimum requirement for interior finish shall be Class II.

Note i. In Use Groups A, I-2 and I-3, Class II interior wall finish material shall be permitted as wainscoting extending not more than 48 inches (1219 mm) above the floor in corridors providing exit access.

803.5 Interior trim: Baseboards, chair rails, moldings, trim around openings and other interior trim, not in excess of 10% of the aggregate wall and ceiling areas of any room or space, shall be of Class I, II or III materials.

803.6 Carpet and carpet-like wall coverings: Textile wall coverings having a napped, tufted, looped, woven, nonwoven or similar surface, shall comply with the following:

1. Such materials shall have a Class I flame spread classification and be installed only in rooms or areas protected by an *automatic sprinkler system* installed in accordance with 780 CMR 9; or
2. Such materials shall be tested in accordance with an eight-foot by 12-foot by eight-foot high (2438 mm by 3658 mm by 2438 mm) room/corner fire test procedure utilizing a product-mounting system, including adhesive, representative of actual installation. Prior to testing, the sample shall be conditioned at 70°F (21°C) ± 5% and at a relative humidity of 50% ± 5% until the sample reaches a rate of weight change of less than 0.1% per day. The product shall be exposed to a flame from a gas diffusion burner for 15 minutes. The fire exposure shall be 40 kW for the first five minutes, followed by an exposure of 150 kW for an additional ten minutes. Such tests shall demonstrate that a product will not spread fire to the edge of the specimen or cause flashover in the test room.

803.7 Design load: Interior wall finish materials shall be capable of resisting the horizontal load specified in 780 CMR 1615.4.

780 CMR 804.0 APPLICATION OF INTERIOR FINISH

804.1 Attachment: Where interior finish is regulated by the requirements of 780 CMR 8, interior finish materials shall be applied or otherwise fastened in such a manner that such materials will not readily become detached when subjected to room temperatures of 200°F (93°C) for not less than 30 minutes.

804.2 Fireresistive and noncombustible construction: Interior finish materials installed on walls, ceilings or structural elements which are required to provide a fireresistance rating or to be of noncombustible construction, shall comply with the provisions of 780 CMR 804.2.1 or 804.2.2.

804.2.1 Application to structural elements: Interior finish materials applied to walls, ceilings or structural elements shall be applied directly against the exposed surface of such structural elements or to furring attached to such surfaces. In concrete or masonry construction, furring of wood or any other material of similar combustible characteristics is permitted. All concealed spaces created by furring shall be *firestopped* at not more than ten-foot (3048 mm) intervals in any direction (see 780 CMR 720.6.6).

804.2.2 Set-out construction: Where the interior finish is set out or dropped distances greater than 1¾ inches (44 mm) from the surface of such elements, only material of which both faces qualify as Class I shall be installed.

Exceptions:

1. In buildings equipped throughout with an *automatic sprinkler system* installed in accordance with 780 CMR 906.2.1 or 906.2.2, Class II finish materials shall be permitted provided that automatic *sprinklers* are also installed in combustible concealed spaces behind the interior finish.
2. Class II or III materials shall be permitted where attached to a backing that complies with 780 CMR 804.3 or to furring applied directly to such backing as provided for in 780 CMR 804.2.1.

804.3 Class II and III materials: Class II and III interior finish materials which are less than ¼ inch in thickness shall be applied directly against a noncombustible backing or a backing that complies with the requirements of 780 CMR 2310.0, unless the tests under which such material has been classified were made with the materials suspended from the noncombustible backing. The backing material shall provide a continuous surface completely behind the finish. Where the backing does not constitute an integral part of the structural elements or system, the backing shall be attached directly to the structural elements or to the furring as required for the application of finish in 780 CMR 804.2, or shall be suspended from the structural members at any distance and all concealed spaces created thereby shall be *firestopped* in accordance with 780 CMR 720.0.

804.4 Type 4 construction: Interior finish materials shall be applied directly to the wood members and decking of buildings of Type 4 construction, or to furring strips applied to such members or wood decking as provided for in 780 CMR 804.2.1.

780 CMR 805.0 FLOOR FINISH

805.1 General: Finished floors or floor covering materials of a traditional type, such as wood, vinyl, linoleum, terrazzo and other resilient floor covering materials, are exempt from the requirements of 780 CMR 805.0. Floor coverings judged by the code official to represent an unusual hazard shall meet the requirements of 780 CMR 805.0.

805.2 Classification: Interior *floor finish* required by 780 CMR 805.3 to be of Class I or Class II materials shall be classified in accordance with ASTM E648 listed in ***Appendix A***. The classifications referred to herein correspond to the classifications determined by ASTM E648 listed in ***Appendix A*** as follows: Class I, 0.45 watts/cm^2; Class II, 0.22 watts/cm^2.

805.2.1 Test report: All carpet required by 780 CMR 805.0 to meet critical radiant flux limitations in accordance with 780 CMR 805.2 shall be tested by an *approved agency*. A copy of the test report identifying and representing the style to be installed shall be provided to the code official upon request. The test report shall identify the carpet by manufacturer (or supplier) and style name, and shall be representative of the current construction of the carpet.

The carpet shall be identified as to manufacturer (or supplier) and style by a hang tag or other suitable method, which shall indicate the classification of the material based upon the limitations specified in 780 CMR 805.2.

805.3 Required classification: Interior *floor finish* in vertical *exits*, *exit* passageways and *exit access corridors* shall not be less than Class I in Use Group I-2 and not less than Class II in Use Groups A, B, E, I-l, I-3, M, R-l and R-2. In all other areas, the interior *floor finish* shall comply with the DOC FF-1 "pill test" (CPSC 16 CFR, Part 1630) listed in ***Appendix A***.

Exception: Where a building is equipped throughout with an *automatic sprinkler system* in accordance with 780 CMR 906.2.1 or 906.2.2, Class II materials are permitted in any area where Class I materials are required and materials complying with the DOC FF-1 "pill test" (CPSC 16 CFR, Part 1630) listed in ***Appendix A*** are permitted in any area where Class II materials are required.

805.4 Rooms and enclosed spaces: Requirements for rooms or enclosed spaces are based upon the spaces being enclosed with partitions extending from the floor to the ceiling. Where partitions do not satisfy this criterion, the room or space is considered part of the *corridor*.

805.5 Other materials: All carpet manufactured for sale in the United States is required by federal regulations to pass the DOC FF-1 "pill test" (CPSC 16 CFR, Part 1630) listed in ***Appendix A***. If a material other than carpet is installed, the material shall be shown to be at least as resistant to flame propagation as a material which passes DOC FF-1 (minimum critical radiant flux of 0.04 watts/cm^2).

780 CMR 806.0 COMBUSTIBLE MATERIALS PERMITTED IN FLOORS OF TYPES 1 AND 2 CONSTRUCTION

806.1 General: Except as provided for in 780 CMR 1014.0 for *stairways* and in 780 CMR 412.0 for *stages* and *platforms*, combustible materials installed in or on floors of buildings of Types 1 and 2 construction shall be as herein specified.

806.2 Sleepers, bucks and grounds: Floor sleepers, bucks, nailing blocks and grounds shall not be constructed of combustible materials, unless the space between the fireresistance rated floor construction and the flooring is either solidly filled with approved noncombustible materials or *firestopped* in accordance with 780 CMR 720.6.7, and provided that such open spaces shall not extend under or through permanent partitions or walls.

806.3 Flooring: Wood finish flooring is permitted to be attached directly to the embedded or *firestopped* wood sleepers, and shall be permitted where cemented directly to the top surface of approved fireresistance rated construction or directly to a wood subfloor attached to sleepers as provided for in 780 CMR 806.2. Combustible insulating boards not more than ½ inch thick and covered with approved finished flooring are permitted for sound deadening or heat insulating where attached directly to a non-combustible floor assembly or to wood subflooring attached to sleepers as provided for in 780 CMR 806.2.

780 CMR 807.0 INTERIOR HANGINGS AND DECORATIONS

807.1 Decorative material restrictions: In occupancies in Use Groups A, E, I-2, I-3 and R-l, all curtains, draperies, hangings and other decorative materials suspended from walls or ceilings shall be noncombustible or be maintained flameresistant in accordance with 780 CMR 807.2 as herein specified ***and 527 CMR 21.00*** as listed in ***Appendix A***.

807.1.1 Noncombustible: The permissible amount of non-combustible decorative hangings shall not be limited.

807.1.2 Flameresistant: The permissible amount of flameresistant decorative hangings shall not exceed 10% of the total wall and ceiling area.

807.2 Acceptance criteria: Where required to be flameresistant under the provisions of 780 CMR, all materials used for artistic enhancement, decorations, draperies, curtains, scenery and hangings shall comply with 780 CMR 807.0. If treated to be flameresistant, these materials shall not generate smoke more dense than that given off by untreated wood or paper burning under comparable conditions when tested in accordance with both the small-scale and large-scale tests in NFiPA 701 listed in ***Appendix A***.

807.2.1 Limitation of approval: All approvals of organic decorative material shall be limited to one year. The owner or the owner's authorized agent shall file an affidavit with the code official which certifies that the process and materials utilized comply with 780 CMR and which states the date of treatment and the warranted period of effectiveness of the process.

807.2.2 Field test for decorative materials: Where documented certification of flameresistance is not provided, the code official shall subject decorative materials that are required to be flameresistant to a field test in accordance with Chapter 10 of NFiPA 701 listed in ***Appendix A***.

807.2.3 Replacement of defective materials: All treated hangings, draperies, canvas and other decorative and tent materials which fail to conform to the field test requirements shall be retreated or replaced by an approved installation.

CHAPTER 9

FIRE PROTECTION SYSTEMS

(This Chapter is Entirely Unique to Massachusetts)

780 CMR 901.0 GENERAL

901.1 Scope: The provisions of 780 CMR 9 shall specify where *fire protection systems* are required and shall apply to the design, installation, maintenance and operation of all *fire protection systems* in all buildings and structures.

901.1.1 Seismic Requirements: All "required" and "non-required" fire protection systems shall be installed in accordance with the Seismic Criteria requirements of 780 CMR 1612.7, Architectural, Mechanical and Electrical Components and Systems.

901.2 Required systems: All *fire protection systems* required by 780 CMR shall be installed, repaired, operated and maintained in accordance with this code and the applicable reference standards listed in ***Appendix A***. All required *fire suppression* and *standpipe systems* shall be provided with at least one automatic supply of fire-extinguishing agent of adequate pressure, capacity and reliability to perform the function intended.

901.3 Nonrequired systems: Any *fire protection system or* portion thereof not required by 780 CMR shall be permitted to be finished for partial or complete protection provided that such installed system meets applicable requirements of 780 CMR. A building permit shall be required for systems installed pursuant to 780 CMR 901.3

901.4 Maintenance: All water based fire protection systems shall be maintained in accordance with NFPA 25 as listed in ***Appendix A***. All other *fire protection systems* shall be maintained in accordance with the requirements of the applicable reference standards and standards listed in ***Appendix A***. The owner, tenant or lessee of every building or structure shall be responsible for the care and maintenance of all fire protection systems, including equipment and devices, to ensure the safety and welfare of the occupants. Fire protection systems shall not be disconnected or otherwise rendered unserviceable without first notifying the local fire department in accordance with M.G.L. c. 148 § 27A.

When installations of fire protection systems are interrupted for repairs or other necessary reasons, the owner, tenant or lessee shall immediately advise the local fire department and shall diligently prosecute the restoration of the protection.

901.5 Threads: All threads provided for fire department connections to *sprinkler systems, standpipes,* yard hydrants or any other fire hose connection shall be compatible with the connections used by the local fire department.

901.6 Signs: All signs required to identify fire protection equipment, equipment rooms and equipment locations shall be constructed of durable materials, be permanently installed and be readily visible. Letters and numbers shall contrast with the sign background, shall be at least two inches in height and shall have an appropriate width-to-height ratio to permit the sign to be read easily from a distance of ten feet. The sign and location shall be approved by the local fire department.

Exception: See also 780 CMR 906.8 for entrance doors to sprinkler control valve rooms and 780 CMR 915.8 for fire department connections.

780 CMR 902.0 DEFINITIONS

902.1 General: The following words and terms shall, for the purposes of 780 CMR 9 and as used elsewhere in 780 CMR, have the meanings shown herein.

Alarm verification: A feature of automatic fire detection systems to reduce unwanted alarms wherein *automatic fire detectors* report alarm conditions for a minimum period of time, or confirm alarm conditions within a given period, after being automatically reset to be accepted as a valid alarm initiation signal (see 780 CMR 918.0).

Approval/Permit To Install: The term refers to permits outside the jurisdiction of the building official, issued under authority of M.G.L. c. 148, § 10A or 527 CMR.

Authority Having Jurisdiction: The term "Authority Having Jurisdiction" as used in the NFPA Standards as referenced in 780 CMR 9, shall mean the building official for enforcement of 780 CMR and the BBRS for interpretation, waiver or variences (see 780 CMR 122.0; see official interpretation number 35-94 listed in Appendix B)

Automatic: As applied to fire protection devices, automatic refers to a device or system that provides an emergency function without the necessity of human intervention and activated as a result of a predetermined temperature rise, rate of temperature rise or increase in the level of combustion products - such as incorporated in an *automatic sprinkler system, automatic fire door, etc.*

Automatic fire suppression system: An engineered system using carbon dioxide (CO_2), foam, wet or dry chemical, a halogenated extinguishing agent, or an *automatic sprinkler system* to detect automatically and suppress a fire through fixed piping and nozzles (see 780 CMR 904.0).

Construction Documents: As defined in 780 CMR 2.

Deluge system: An *automatic sprinkler system* consisting of open *sprinklers* with *water supply* valves activated by a separate automatic detection system (see 780 CMR 908.0).

Detector, heat: An alarm-initiating device that detects abnormally high temperature or rate of temperature rise (see 780 CMR 918.0).

Detector, smoke: An alarm-initiating device that detects the visible or invisible particles of combustion (see 780 CMR 918.0).

Emergency Voice/alarm signaling system: A system that provides, to the occupants of a building, dedicated manual or automatic facilities, or both, for originating and distributing voice instructions, as well as alert and evacuation signals that pertain to a fire emergency (see 780 CMR 917.0).

Fire alarm box, manual: A manually operated alarm-initiating device that activates a fire protective signaling system (see 780 CMR 917.0).

Fire command station (Fire command center): The principal location where the status of the detection, alarm, communications and control systems is displayed, and from which the system(s) has the capability for manual control (see 780 CMR 403.7 and 917.9).

Fire Department Designee: An individual authorized by the chief of the fire department to review and approve fire protection system plans and installation.

Fire detector, automatic: An alarm-initiating device that automatically detects heat, smoke or other products of combustion (see 780 CMR 918.0).

Fire Protection Construction Documents: Documents containing the requirements of 780 CMR 903.1.1, 903.1.2, 903.1 .3.

Fire protection system: Devices, equipment and systems used to detect a fire, activate an alarm, suppress or control a fire, or any combination thereof.

Fire Protective Signaling System (Fire Alarm System): A system or portion of a combination system consisting of components and circuits arranged to monitor and annunciate the status of fire alarm or supervisory signal initiating devices and to initiate appropriate response to those signals.

Household Fire Warning System: A household fire warning system consists of single or multiple station detectors or a listed control unit with automatic fire detectors and occupant notification appliances. The household fire warning system serves only one dwelling unit, patient room, hotel room or other single area depending on use group requirements in 780 CMR 919.1 through 919.3

Installing Contractor:An individual or firm duly licensed to install fire protection systems. (See 780 CMR 903.3)

- ***Automatic Sprinklers Systems - M.G.L. c. 146, §§ 81 through 85A, 528 CMR 11.00 and 12.00***
- ***Fire Extinguishing systems - M.G.L. c. 148, §§ 58, 527 CMR 23.00***
- ***Fire Alarm Systems - M.G.L. c. 141, §§ 1 through 10, 237 CMR 1.00 through 6.00***

Maintenance of Fire Protections Systems: Replacement or repair of any component or components of a fire protection system, where such does not affect system performance and compatibility. (Also see *Modifications, Alterations, Additions or Deletions to Fire Protection Systems*). No building permit is required for maintenance. Other permits, however, may be required pursuant to M.G.L. c.148, § 27A and 527 CMR.

Modifications, Alterations, Additions or Deletions to Fire Protection Systems: Any changes which affect the performance of the fire protection system. (Also see *maintenance*). Such changes require a building permit and are subject to other permitting requirements pursuant to M.G.L. c. 148, § 27A.

Master Box: A municipal fire alarm box that may also be operated by remote means.

Municipal Fire Alarm System: A system of alarm initiating devices, receiving equipment, and connecting circuits (other than a public telephone network) used to transmit alarms from street locations to the public fire service communications center.

Preaction system: A fire *sprinkler* system employing automatic *sprinklers* attached to a piping system containing air with a supplemental fire detection system installed in the same areas as the *sprinklers*. Actuation of the fire detection system automatically opens a valve that permits water to flow into the *sprinkler* piping system and to be discharged from any open *sprinklers* (see 780 CMR 906.9.6).

Proprietary supervising station: Refer to the definition in chapter 1 of NFPA-72 and to further details as identified in chapter 4 of NFPA-72 as listed in Appendix A.

Registered Professional Engineer: A Registered Professional Engineer registered by the Board of Registration of Professional Engineers and of Land Surveyors in accordance with M.G.L. c. 112, §§ 81D through 81T and 250 CMR (see 780 CMR 903.1.3 and 903.5).

Remote station fire alarm system supervising station: Refer to the definitions in chapter 1 of NFPA-72 and to further details as identified in chapter 4 of NFPA-72 as listed in Appendix A.

Shop Drawings: Scaled detailed working drawings (system layout) and equipment specifications (cut sheets) indicating all information in accordance with requirements of the applicable NFPA Standards for the specific fire protection systems to be installed in accordance with the Registered Professional Engineer's plans and specifications.

Smoke detector, multiple station: Single-station smoke detectors that are capable of being interconnected such that actuation of one causes all integral or separate audible alarms to operate (see 780 CMR 919.0).

Smoke detector, single station: An assembly incorporating the detector, the control equipment and the alarm-sounding device in one unit, which is operated from a power supply either in the unit or obtained at the point of installation (see 780 CMR 919.0).

NON-TEXT PAGE

Smoke detector, system type: A smoke detector designed to be conneted to a fire alarm control panel.

Sprinkler: A device, connected to a *water supply* system, that discharges water in a specific pattern for extinguishment or control of fire (see 780 CMR 906.0).

Sprinkler system, automatic: A *sprinkler* system, for fire protection purposes, is an integrated system of underground or overhead piping designed in accordance with fire protection engineering standards. The system includes a suitable *water supply.* The portion of the system above the ground is a network of specially or hydraulically designed piping installed in a building, structure or area, generally overhead, and to which automatic *sprinklers* are connected in a systematic pattern. The system is usually activated by heat from a fire and discharges water over the *fire area* (see 780 CMR 906.0).

Sprinkler system, limited area: An *automatic sprinkler system* consisting of not more than 20 *sprinklers* within a *fire area* (see 780 CMR 907.0).

Standpipe system: A *standpipe* system is a *fire protection system* consisting of an arrangement of piping, valves, hose outlets and allied equipment installed in a building or structure (see 780 CMR 914.0).

Supervisory device: An initiating device used to monitor the conditions that are essential for the proper operation of *automatic fire-protection systems* (i.e., switches used to monitor the position of gate valves, a low air-pressure switch on a dry-pipe *sprinkler system,* etc.) (see 780 CMR 923.0).

U.L. Listed or FM approved central station service: Central station service as defined in Chapter 1 of NFPA-72 and as further identified in chapter 4 of NFPA 72 as listed in Appendix A.

Water supply, automatic: A water supply that is not dependent on any manual operation, such as making connections, operating valves or starting pumps (see 780 CMR 914.5).

780 CMR 903.0 FIRE PROTECTION SYSTEMS APPROVAL/ACCEPTANCE

903.1 Required: Complete *fire protection construction documents* shall be submitted in accordance with 780 CMR 110 and a building permit obtained prior to the installation of all "required" or "non required" fire protection systems, including *modifications, alterations, additions or deletions* to an existing fire protection system. The *fire protection construction documents* shall contain sufficient information to completely describe the *fire protection systems*, including operational features. The information required pursuant to 780 CMR 903.0 shall include, where required, the items listed in 780 CMR 903.1.1:

Exception 1: *Maintenance*; no building permit required.
Exception 2: For modifications, alterations, additions or deletions which do not affect system performance or compatibility; no building permit is required unless otherwise directed by the Building Official (Note also refer to M.G.L. c.148, § 27A).

903.1.1 Fire Protection Construction Documents:

1. a. Basis (methodology) of design for the protection of the occupancy and hazards for compliance with 780 CMR and applicable NFPA Standards, in the form of a narrative report.
   b. Sequence of operation of all fire protection systems and operation in the form of a narrative report.
   c. Testing criteria to be used for final system acceptance in the form of a narrative report.
2. Building and site access for fire fighting and/or rescue vehicle(s) and personnel.
3. Fire hydrant(s) location and water supply information.
4. Type/description and design layout of the automatic sprinkler system(s).
5. Automatic sprinkler system(s) control equipment location.
6. Type/description and design layout of the automatic standpipe system(s).
7. Standpipe system hose valve(s) type and location.
8. Fire department siamese connection type(s) and location.
9. Type/description and design layout of the fire protective signaling system(s).
10. Fire protective signaling system(s) control equipment and remote annunciator location.
11. Type/description and design layout of the smoke control or exhaust system(s).
12. Smoke control or exhaust system(s) control equipment location.
13. Building life safety system features (auxiliary functions) required to be integrated as part of the fire protective signaling system(s).
14. Type/description and design layout of the fire extinguishing system(s).
15. Fire extinguishing system(s) control equipment location.

16. Fire protection system(s) equipment room location.
17. Fire protection system(s) equipment identification and operation signs.
18. Fire protection system(s) alarm/ supervisory signal transmission method and location.

903.1.2 Plans: All fire protection system plans shall contain sufficient information to identify the occupancy, hazards, system and equipment arrangements, system and equipment sizing, systems specifications, systems sequence(s) of operation and design/engineering calculations.

903.1.3 Design: All fire protection systems and fire protection system operation including building and site features as identified in 780 CMR 903.1 1 shall be designed and specified by a qualified *Registered Professional Engineer(s)*except as provided in M.G.L. c. 143, § 54A and any profession or trade as provided in M.G.L. c. 112, § 60L and M.G.L. c. 112, § 81R. All plans shall bear the original seal and signature of the *Registered Professional Engineer(s),* except as provided in M.G.L. c. 143, § 54A and any profession or trade as provided in M.G.L. c. 112, § 60L and M.G.L. c. 112, § 81R. Specifications shall include requirements for the preparation of shop drawings when required by 780 CMR or applicable NFPA Standards. The *Registered Professional Engineer(s) or other legally recognized professional (M.G.L. c. 112, § 81R) shall* be responsible for the review and certify that all shop drawings conform to the approved fire protection *construction documents* as submitted for the building permit and approved by the building official.

903.1.4 As-built plans: In accordance with the applicable referenced standards, as-built plans shall be prepared by the contractor responsible for the installation of the fire protection system for the following occupancies:

(a) High-rise buildings
(b) Buildings and structures of Use Group A with a total occupant load exceeding 1000.
(c) Buildings and structures of Use Group H.
(d) Use Group I-2 and I-3 except I-2 Uses provided for in 780 CMR 424.
(e) Bulk Merchandising/Retail occupancies (See 780 CMR 416.0).

As-built plans shall be provided to the owner upon completion.

903.1.5 Safeguarding Construction: The *fire protection construction documents* shall provide specifications for conformance to 780 CMR 33 and NFPA-241 listed in ***Appendix A*** in order to safeguard against fires during construction, alterations and demolition of all buildings and structures regulated by 780 CMR.

903.2 Authority: In accordance with the requirements of 780 CMR 110 and 780 CMR 903.1 the building of official shall transmit one set of the *fire protection construction documents* (780 CMR 903.1.1) and *building construction documents* to the head of the fire department or his designee for review and approval of the items specified in 780 CMR 903.1.1.

Note:
1. M.G.L. c. 148 §§ 26G, 26H and 26I, when adopted by a city or town, will impact the fire protection requirements of 780 CMR 9. A building official shall consult *Official Interpretation* Number 45-96, listed in Appendix B, for guidance, where communities have adopted M.G.L. c. 148, §§ 26G, 26H, and/or 26I.
2. In addition to the building permit requirements for fire protection systems in 780 CMR, M.G.L. c. 148 § 10A and 527 CMR may impose additional installation permitting requirements.

903.2.1 Alternative Fire Protection Design Methodologies - Independent Engineering Review: Where alternative design methodologies are utilized and where such methodologies result in designs which vary from any prescriptive requirement of 780 CMR, the owner shall engage an independent registered professional engineer to review said alternative design methodologies. The scope of the independent registered professional engineer review shall include, but not be limited to the following;

(a) Review of the design assumptions, methodologies and resulting proposed system designs, to determine whether the proposed fire protection system designs and any other systems which are affected by the design assumptions, are consistent with the general objectives and prescriptive provisions of this code and to determine whether or not the methodologies and assumptions conform to accepted engineering practice;
(b) Preparation of a written report to the building official as to the appropriateness of the proposed design, specifically listing any variances from the prescriptive provisions of 780 CMR and describing, in detail, the design provisions used to achieve compliance.

If the reviewing engineer concurs with the proposed design, the owner shall make application for a variance, to the State Building Code Appeals Board as provided in 780 CMR 122. In addition to all supporting information and materials, the reviewing engineer's report required in 780 CMR 903.2.1(b) shall be included in the application for variance.

A building permit shall not be issued until the variance, if required, has been granted, or unless the building permit is issued in part, as provided for in 780 CMR 111.13.

903.3 Fire Protection Systems Installation: Fire protection systems shall be installed by contractors and personnel appropriately licensed in the Commonwealth of Massachusetts (*licensed installing contractor*). Shop drawings required for submittals and reviews by the *Registered Professional Engineer*, or other legally recognized professional (M.G.L. c. 112,§ 81R), by 780 CMR 903.1.3 or by applicable NFPA Standards shall note the name(s), license number(s) and license expiration date(s) of the contractor(s) installing the fire protection systems.

903.4 Acceptance: In accordance with the provisions of 780 CMR 120, a Certificate of Occupancy shall not issue until the building official and the head of the fire department or their designees have witnessed a satisfactory functional test of all *fire protection systems,* installed in accordance with the approved *fire protection construction documents*. All fire protection systems shall be tested in accordance with the applicable provisions of 780 CMR and NFPA Standards and approved testing criteria and operational sequence as submitted in 780 CMR 903.1.1, items 1.b and c. In addition, the following documents and/or information shall be simultaneously submitted to the building official and head of the fire department or their designees prior to the witnessing of the operational fire protection system(s) testing:

1. Certification, from the *Registered Professional Engineer* or other legally recognized professional (M.G.L. c. 112, § 81R) responsible for the design in accordance with 780 CMR 903.1.3 stating that the fire protection systems have been installed in accordance with the approved *fire protection construction* documents and that he has reviewed the shop drawings for conformance to 780 CMR 903.3 and has identified deviations if any, from the approved *fire protection construction documents*.
2. Confirmation by the building owner/developer or authorized representative that they have received the as-built fire protection system shop drawings from the *installing contractor* and that *the Registered Professional Engineer* or other legally recognized professional (M.G.L. c. 112, § 81R) has certified their reasonable accuracy.
3. Material, Test, Performance and Completion Certificates, properly executed by the *installing contractor* in accordance with the applicable NFPA Standards.

Exception: In lieu of witnessing a satisfactory functional test, the building official and head of the fire department or their designees may accept a final performance acceptance test report from a *Registered Professional Engineer or other legally recognized professional (M.G.L. c. 112, § 81R).* Said report shall certify that a complete satisfactory functional test of all fire protection systems in accordance with the approved testing criteria and operational sequence have been witnessed.

903.4.1 Conditional Acceptance: The requirements of 780 CMR 903.4 shall not preclude the issuance of a temporary Certificate of occupancy by the Building Official in accordance with 780 CMR 120.3.

780 CMR 904.0 FIRE SUPPRESSION SYSTEMS

904.1 Where required: *Automatic fire suppression systems* shall be installed where required by 780 CMR and in the locations indicated in 780 CMR 904.1 through 904.9.

Exceptions:

1. An *automatic fire suppression system* shall not be required in portions of buildings that comply with 780 CMR 406.0 for open parking structures less than 70 feet in height above mean grade.
2. In telecommunications equipment buildings, an *automatic fire suppression system* shall not be required in those spaces or areas occupied exclusively for telecommunications equipment, associated electrical power distribution equipment, batteries and standby engines, provided that those spaces or areas are equipped throughout with an *automatic fire detection system* in accordance with 780 CMR 918.0 and are separated from the remainder of the building with fire separation assemblies consisting of one-hour fireresistance rated walls and two-hour fireresistance rated floor/ceiling assemblies.
3. Automatic sprinkler protection is precluded in: (a) all new construction elevator machine rooms of traction/drum elevators; (b) all new construction elevator machine rooms of hydraulic elevators; (c) all new construction elevator hoistways and elevator pits. ***(Note that capped, inactive sprinkler piping would be allowed)**

Such elevator machine rooms and hoistway/pit enclosures shall be constructed to afford at least the fireresistance rating specified in Table 602 and otherwise as required/allowed by the applicable portions of 780 CMR 7.0 (typically, but not always, the hoistway/pit and machine room will have a minimum fireresistance rating of two hours with elevator opening protectives rated at 1½ hours but ratings of one hour for hoistway/pit and machine rooms and ¾ hour for elevator opening protectives may be allowed).

Where Table 602 requires a fireresistance rating for elevator machine rooms, hoistways and/or pits, such rating must be provided unless such ratings are governed by other Building Code Sections.

For elevator installation within atriums also see 780 CMR 404 for additional fireresistance rating guidance.

Where the elevator machine room is determined to be a true penthouse roof structure, also refer to 780 CMR 1510 for additional fireresistance rating requirements.

Note: Also Refer to M.G.L. c. 148, § 26A and 26G

904.1.1 Additional requirements: When a building or structure is provided with a fire alarm system, all extinguishing systems installed in accordance with the provisions of 780 CMR 904 through 914, shall be connected to the fire alarm system in accordance with the requirements of NFPA 72 as listed in ***Appendix A***.

904.1.1.1 Fire pump requirements: Refer to 780 CMR 924.

904.2 Use Groups A-1, A-3, A-4, B, E, M, S-1, F-1 in buildings of 12,000 sf or greater in aggregate floor area: An automatic fire suppression system shall be provided throughout all portions or uses of all buildings of 12,000 sf or greater in aggregate area when any of the following *uses* are located within the building;

A-1, A-3, A-4, B, E, M, S-1, F-1

780 CMR 904.2 shall apply whether or not the *use* is separated from any other *use* within the building by *fire separation assemblies*.

Exceptions:

1. Existing buildings: *Existing buildings* which qualify as such in accordance with 780 CMR 3400.3.1 and which undergo a partial change in *use* to a *use* or *uses* specified in 780 CMR 904.2 or are mixed *use* buildings which undergo renovation of a *use* or *uses* specified in 780 CMR 904.2, shall be provided with automatic fire suppression systems in accordance with the following:

(a) only in those portions of the building which have been changed in *use* and only when such space or spaces exceed 12,000 sf in *aggregate* floor area.

(b) only in those portions of the building which have been altered or renovated provided that such renovation constitutes *substantial alterations or substantial renovations*, in accordance with 780 CMR 3401 and only when such space or spaces exceed 12,000 sf in aggregate floor area.

2. Public Garages: Public Garages shall conform to 780 CMR 408.0.

Note: See also M.G.L. c. 148, §§ 26A and 26G.

904.3 Use Group A-2: An *automatic fire suppression system* shall be provided throughout all buildings with an occupancy in use group A-2 when the occupant load of the A-2 use is 50 or greater.

904.3.1 A-2 and residential mixed use buildings: Where a building contains one or more residential dwelling units and also contains an A-2 Use and where the A-2 Use has an occupant load of 50 or greater, an automatic fire suppression system shall be provided throughout the building including any common areas connecting the A-2 Use and the Residential Use (*see* St. 2004, c. 304, § 4A).

Exception:

1. Existing buildings: *Existing buildings* which qualify as such in accordance with 780 CMR 3400.3.1 which undergo a partial change in *use* to an A-2 *use* or partial renovation of an existing A-2 *use* shall be provided with an automatic fire suppression system only in those portions of the building which have been changed to an A-2 *use* or those existing A-2 *uses* which have been renovated when such renovation constitutes *substantial alterations or substantial renovations*, in accordance with 780 CMR 3401 and only when the proposed or existing A-2 *use* exceeds 5,000 sf in aggregate floor area.

904.4 Use Group H: An *automatic fire suppression system* shall be provided throughout all buildings of Use Group H.

Exception: Magazines used for the storage of Use Group H-1 materials which are constructed and located in accordance with NFPA 495 and 527 CMR listed in ***Appendix A***.

Note: See also M.G.L. c. 148, §§ 26A and 26G.

904.5 Use Group I: An *automatic fire suppression system* shall be provided throughout all buildings of Use Group I.

Note: See also M.G.L. c. 148, §§ 26A and 26G.

904.6 Use Group R-1: An *automatic fire suppression system* shall be provided throughout all buildings or spaces of Use Group R-1 in accordance with 780 CMR 906.2.1 or 906.2.2.

904.7 Use Group R-2: An *automatic fire suppression* system shall be provided throughout all buildings with an occupancy in Use Group R-2 in accordance with 780 CMR 906.2.1 or 906.2.2.

Exception: Buildings having no more than three dwelling units shall be permitted to have an automatic fire suppression system installed in accordance with NFPA-13D, "SPRINKLER SYSTEMS", listed in *Appendix A*, subject to the following conditions:

a. Every automatic sprinkler system shall have at least one automatic water supply or a stored water supply source in accordance with NFPA-13D where the minimum quantity of stored water shall equal the water demand rate times 20 minutes.

b. 780 CMR 919.3.2, Exception 2, and 780 CMR 919.5, Exception, shall not apply when the automatic fire suppression system installed is installed in accordance with NFPA-13D.

This Exception shall apply to new construction or substantial renovation, or substantial alteration as defined in 780 CMR, Chapter 34

Note: See also M.G.L. c. 148, §§ 26A and 26I.

904.8 Windowless story: An *automatic fire suppression system* shall be provided throughout every story or *basement* of all buildings where there is not provided at least one of the following types of openings:

1. An exterior *stairway* that conforms to the requirements of 780 CMR 1014.0, or an outside ramp that conforms to the requirements of 780 CMR 1016.0, leading directly to grade in each 50 linear feet (15240 mm) or fraction thereof of exterior wall in the story or *basement*, on at least one side of the building.
2. Openings entirely above the adjoining ground level totaling 20 square feet (1.9 m^2) in each 50 linear feet (15240 mm) or fraction thereof of exterior wall in the story or *basement*, on at least one side of the building. Openings shall have a least dimension of not less than 22 inches (559 mm), and shall have a minimum net clear opening of five square feet (0.5m^2). Access to such openings from the exterior shall be provided to the fire department and such openings shall be unobstructed to allow fire-fighting and rescue operations from the exterior.

When openings in a story are provided on only one side and the opposite wall of such story is more than 75 feet (22860 mm) from such openings, the story shall be equipped throughout with an *automatic sprinkler system*, or openings as specified herein shall be provided on at least two sides of the exterior walls of the story. If any portion of a basement is located more than 75 feet (22860 mm) from the openings required in 780 CMR 904.0, the *basement* shall be provided with an *automatic sprinkler system*.

Exception: Occupancies in Use Group R-3.

904.9 Other required suppression systems: In addition to the requirements of 780 CMR 904.2 through 904.8, *automatic fire suppression systems* for certain buildings and areas shall be provided in accordance with Table 904.9.

Table 904.9
ADDITIONAL REQUIRED SUPPRESSION SYSTEMS(1)

780 CMR Section	Subject
302.1.1	Specific occupancy areas
402.10; 402.15.2	Covered mall buildings
403.2	High-rise buildings
404.2	Atriums
408.3.1	Public garages
408.4	Fuel-dispensing areas
426.0	Bulk Merchandizing/Warehouse Occupancies
780 CMR Section	Subject
411.7	Sound stages
412.6	Stages and enclosed platforms
413.4	Special amusement buildings
416.4	HPM facilities
419.3	Paint spray booths and storage rooms
	Open parking structures more than 70 feet in height above the mean grade (M.G.L. c. 148, § 26A)
507.1	Unlimited area buildings
1020.3	Exit lobbies
2806.4	Drying rooms
2807.6	Waste and linen chutes and termination and incinerator rooms
2808.4	Refuse vaults

Note (1) See also M.G.L. c. 143, § 97A, M.G.L. c. 148, §§ 26A, 26G, 26G½, 26H, 26I and M.G.L. c. 148A.

780 CMR 905.0 SUPPRESSION SYSTEM AGENT COMPATIBILITY

905.1 Agent compatibility: The extinguishing agent for each *suppression system* shall be compatible with the type of hazard and fire. Each fixed *fire suppression system* shall be of an approved type and shall be designed and installed in accordance with the requirements of 780 CMR.

905.1.1 Special hazards: In rooms or buildings containing combustibles (such as aluminum powder, calcium carbide, calcium phosphide, metallic sodium and potassium, quick-lime, magnesium powder or sodium peroxide) that are incompatible with water as an extinguishing agent, other extinguishing agents shall be utilized.

780 CMR 906.0 FIRE SPRINKLER SYSTEM

906.1 General: *Automatic sprinkler systems* shall be approved and shall be designed and installed in accordance with the provisions of 780 CMR.

906.2 Equipped throughout: Where the provisions of 780 CMR require that a building or portion thereof be equipped throughout with an *automatic sprinkler system*, the system shall be designed and installed in accordance with 780 CMR 906.2.1, 906.2.2 or 906.2.3.

NON-TEXT PAGE

Exception: Where water as an extinguishing agent is not compatible with the fire hazard (see 780 CMR 905.1) or is prohibited by a law, statute or ordinance, the affected area shall be equipped with an approved *automatic fire suppression system* utilizing a suppression agent that is compatible with the fire hazard.

906.2.1 NFiPA 13 systems: The system shall be designed and installed in accordance with NFiPA 13 listed in *Appendix A*.

906.2.2 NFiPA 13R systems: In buildings four stories or less in height, systems designed and installed in accordance with NFiPA 13R listed in *Appendix A* shall be permitted in Use Group I-1 buildings with not more than 16 occupants and in Use Group R buildings.

906.2.3 NFiPA 13D systems: In Use Group R-3 buildings with at least two-hour fireresistance rated *fire separation assemblies* between *dwelling units*, or in Use Group I-1 buildings with not more than eight occupants, systems designed and installed in accordance with NfiPA 13D listed in *Appendix A* shall be permitted.

906.3 Design: Design documentation shall be in accordance with 780 CMR 903.

906.4 Actuation: Water *sprinkler systems* shall be automatically actuated unless otherwise specifically provided for in 780 CMR.

906.5 Sprinkler alarms: Approved audible and visual alarm devices shall be connected to every water *sprinkler system*. Such alarm devices shall be activated by water flow and shall be located in an approved location on the exterior of the building and throughout the building in accordance with the requirements of NFPA-72 listed in *Appendix A*.

906.6 Water-control valve identification: All valves controlling water to *fire protection systems* shall be provided with permanently attached identification tags indicating the valves' function and what is controlled.

906.7 Sprinkler riser: A *sprinkler system* riser which also serves as the wet standpipe riser in buildings required to have or having both systems, shall conform to 780 CMR 914.6.

906.8 Signs: Where sprinkler control valves are located in a separate room or building, a sign shall be provided on the entrance door. The lettering shall be at least 2½ inches (63.5 mm) in height and shall otherwise conform to 780 CMR 901.6 and shall read "Sprinkler Control Valves."

906.9 Acceptance tests: All *sprinkler systems* shall be tested in accordance with the applicable NFPA

Standards used for *sprinkler system* design and Installation and listed in *Appendix A*.

906.9.1 Underground connections: Underground mains and lead-in connections shall be flushed and tested in accordance with NFiPA 13 and 24 listed in *Appendix A*.

906.9.2 Hydrostatic test: All *sprinkler systems* shall be tested hydrostatically in accordance with the applicable NFPA Standards listed in *Appendix A*.

780 CMR 907.0 LIMITED AREA SPRINKLER SYSTEMS

907.1 General: A *limited area sprinkler system* shall be of an approved type and shall be installed in accordance with the provisions of 780 CMR 907.0. Complete *fire protection construction documents* shall be provided. (See 780 CMR 903.0.)

907.2 Where permitted: Where the provisions of 780 CMR require the installation of a *fire suppression system*, and a water *sprinkler* extinguishing system is used with a limited number of *sprinklers*, a *limited area sprinkler system* that complies with the requirements of 780 CMR 907.0 is permitted to be installed.

907.2.1 Special occupancy areas: A *limited area sprinkler system* shall be permitted within special occupancy areas as designated in 780 CMR 4 or within specific occupancy areas as designated in 780 CMR 302.1.1, provided that the area is enclosed within *fire separation assemblies* as required by 780 CMR, and 20 *sprinklers* or less are required to protect each separately enclosed area. Where nonfireresistance rated separation walls are permitted by Table 302.1.1 to enclose contiguous specific occupancy areas on one floor, the areas shall be considered to be one separately enclosed area for the purposes of determining the number of *sprinklers* based on the spacing limitations of NFPA 13 listed in *Appendix A*.

907.2.2 Unenclosed floor openings, waste and linen chutes, and kitchen and hazardous exhaust systems: A *limited area sprinkler system* shall be permitted to protect unenclosed *escalator* floor openings that comply with 780 CMR 907.2.2.1, chutes used for waste or linen collection, commercial kitchen exhaust systems and duct systems that exhaust *hazardous materials*.

907.2.2.1 Water curtain: The area of the floor opening shall not exceed twice the horizontal projected area of the *escalator* and the opening shall not connect more than four stories in occupancies in other than Use Groups B and M and the opening shall be protected by a draft curtain and a closed *sprinkler* water system conforming to NfiPA 13 listed in *Appendix A*.

Note: Relative to escalator floor openings, also see 780 CMR 713.3.

907.3 Design: Except as otherwise provided for in 780 CMR 907.0, a *limited area sprinkler system* shall be designed and installed in accordance with 780 CMR 906.0.

907.4 Actuation: A *limited area sprinkler system* shall be automatically actuated.

907.5 Sprinkler alarms: Alarms and alarm attachments shall be required and shall be located and installed in accordance with the requirements of 780 CMR 906.5.

907.6 Standpipe connection: The *water supply* for the *limited area sprinkler system* shall be from the building *standpipe system* where the building is equipped with a *standpipe system* that is sized for a 500-gallon-per-minute (0.032 m^3/s) minimum flow and has an *automatic water supply* (see 780 CMR 914.5).

907.6.1 Domestic supply: Where *limited area sprinkler systems* are supplied from the domestic water system, the domestic water system shall be designed to support adequately the design flow of the largest number of *sprinklers* required to be hydraulically calculated by NFiPA 13 listed in *Appendix A* in any one of the enclosed areas plus the domestic demand.

907.6.2 Cross connection: The potable water supply shall be protected against backflow in accordance with the requirements of the Plumbing and Gas Code (248 CMR), and the Department of Environmental Protection Regulations, 310 CMR as listed in *Appendix A* as well as any cross-connection protection criteria legally set forth by the water supplier/purveyor having local jurisdiction.

907.6.3 Domestic connection: Shutoff valves shall not be permitted in the *suppression system* piping. *Water supply* shall be controlled by the riser control valve to the domestic water piping.

Exception: Shutoff valves in the *sprinkler system* piping are permitted provided that such valves are supervised in accordance with 780 CMR 923.0.

907.7 Acceptance tests: All limited area *sprinkler systems* shall be tested as stipulated in 780 CMR 906.9.

780 CMR 908.0 WATER-SPRAY FIXED SYSTEMS

908.1 General: Water-spray fixed systems for fire suppression shall be of an approved type and shall be installed in accordance with the provisions of 780 CMR and NFiPA 15 listed in *Appendix A*. A water-spray fixed system is a system connected to a reliable source of water supply and equipped with normally open water-spray nozzles for specific discharge and distribution over the surface or area to be protected.

908.2 Design: Complete *fire protection construction documents* and hydraulic calculations shall be submitted for review prior to installation. The submittal shall include nozzle layouts, friction loss, calculations, *water supply* data and a detailed layout of the entire area to be protected. (See 780 CMR 903.0.)

908.3 Actuation: Water-spray systems shall be automatically actuated and shall be provided with a manual means of actuation.

908.4 Acceptance tests: All new system piping shall be flushed and tested in accordance with the provisions of NFiPA 15 listed in ***Appendix A***.

780 CMR 909.0 CARBON DIOXIDE EXTINGUISHING SYSTEMS

909.1 General: Carbon dioxide extinguishing systems shall be of an approved type and shall be installed in accordance with the provisions of 780 CMR and NFiPA 12 listed in ***Appendix A***. A carbon dioxide extinguishing system is a system which supplies CO_2 from a pressurized vessel through fixed pipes and nozzles.

909.2 Design: The details of the system indicated on the *fire protection construction documents* shall include information and calculations of the amount of carbon dioxide; the location and flow rate of each nozzle including equivalent orifice area; and the location and size of the carbon dioxide storage facility. Information shall be submitted pertaining to the location and function of *detecting devices*, operating devices, auxiliary equipment and electrical circuitry, if used. Sufficient information shall be indicated to identify properly the apparatus and devices used. Any special features shall be adequately explained. (See 780 CMR 903.0.)

909.3 Actuation: Carbon dioxide extinguishing systems shall be automatically actuated and shall be provided with a manual means of actuation.

909.4 Safety requirements: Where persons will enter or be trapped in atmospheres made hazardous by carbon dioxide discharge, warning signs and discharge alarms shall be provided.

909.5 Acceptance tests: All carbon dioxide extinguishing systems shall be tested in accordance with NFiPA 12 listed in ***Appendix A***. A completed system shall be tested for tightness up to the selector valve, and for continuity of piping with free unobstructed flow beyond the selector valve. The labeling of devices with proper designations and instructions shall be checked. Operational tests shall be conducted on all devices except cylinder valves in multicylinder high-pressure systems. Where conditions prevail that make it difficult to determine adequately the system requirements or design, a suitable discharge test and concentration analysis shall be made.

780 CMR 910.0 DRY-CHEMICAL EXTINGUISHING SYSTEMS

910.1 General: Dry-chemical extinguishing systems shall be of an approved type and shall be installed in accordance with the provisions of 780 CMR and NFiPA 17 listed in ***Appendix A***. A dry-chemical extinguishing system is a system consisting of dry chemical and expellant gas storage tanks, fixed piping and nozzles used to assure proper distribution of an approved extinguishing agent to a specific fire hazard or into an area of potential fire.

910.2 Design: The details of the system indicated on the *fire protection construction documents* shall include sufficient information and calculations of the amount of dry chemical; the size, length and arrangement of connected piping, or piping and hose; and a description and location of nozzles so that the adequacy of the system can be determined. Information shall be submitted pertaining to the location and function of *detecting devices*, operating devices, auxiliary equipment and electrical circuitry, if used. Sufficient information shall be indicated to identify properly the apparatus and devices used. Any special features shall be adequately explained. (See 780 CMR 903.0.)

910.3 Actuation: Dry-chemical extinguishing systems shall be automatically actuated and shall be provided with a manual means of actuation.

910.4 Safety requirements: Where persons will be exposed to a dry-chemical discharge. warning signs and discharge alarms shall be provided.

910.5 Acceptance tests: All dry-chemical extinguishing systems shall be tested in accordance with NFiPA 17 listed in ***Appendix A***. A completed system shall be tested by a discharge of expellant gas through the piping and nozzles. Observations for gas leakage and for continuity of piping with free unobstructed flow shall be made. Observations shall be made of the flow of expellant gas through all nozzles. The labeling of devices with proper designations and instructions shall be checked. After testing, all piping and nozzles shall be blown clean using compressed air or nitrogen, and the system shall be properly charged and placed in the normal "set" condition.

910.5.1 Discharge test: All systems shall be tested by a discharge of expellant gas through the piping and nozzles with observations being made of the flow of expellant gas through all nozzles as well as observing for leakage and continuity of piping with free unobstructed flow.

910.6 Range hoods: In addition to the requirements of 780 CMR 910.0 and the applicable NFPA standards listed in ***Appendix A***, range hood dry-chemical systems shall bear the *label* of an *approved agency*.

The system shall be installed in accordance with the manufacturer's installation instructions. The dry-chemical agent of the system shall be nontoxic.

780 CMR 911.0 FOAM-EXTINGUISHING SYSTEMS

911.1 General: Foam-extinguishing systems shall be of an approved type and shall be installed in accordance with the provisions of 780 CMR and NFiPA 11, 11A and 16 listed in ***Appendix A***. A foam-extinguishing system is a special system designed to discharge, either mechanically or chemically, a foam made from concentrates, over the area to be protected.

911.2 Design: The details of the system indicated on the *fire protection construction documents* shall include complete computations show-testing pressure drop in all system piping, friction loss calculations of liquid lines and a detailed layout of the entire hazard area to be protected. Hydraulic characteristics of foam proportioners and foam makers as determined by tests shall be supplied by the manufacturer to the department (including the range of operating conditions required for the proposed installation) to permit determination of the adequacy of the hydraulics of the proposed protection. (See 780 CMR 903.0.)

911.3 Actuation: A foam-extinguishing system shall be automatically actuated and shall be provided with a manual means of actuation.

911.4 Safety requirements: In any proposed use of a medium- or high-expansion foam where persons will be exposed to the foam discharge, warning signs and discharge alarms shall be provided.

911.5 Acceptance tests: All foam-extinguishing systems shall be tested in accordance with NFiPA 11, l 11A and 16 listed in ***Appendix A***. The system shall be subjected to a flow test to insure that the hazard area is fully protected in compliance with the design specifications, and to determine flow pressures, actual discharge capacity, foam quality, consumption rate of foam-producing materials, manpower requirements and other operating characteristics.

780 CMR 912.0 HALOGENATED EXTINGUISHING SYSTEMS

912.1 General: Halogenated extinguishing systems shall be of an approved type and shall be installed in accordance with the provisions of 780 CMR and NFiPA 12A and 12B listed in ***Appendix A***. A halogenated extinguishing system is a system consisting of pipes, open nozzles and a container of halogenated agent under pressure.

912.2 Design: The details of the system indicated on the *fire protection construction documents* shall include information and calculations of the amount of extinguishing agent; the container storage pressure; the location and flow rate of each nozzle including equivalent orifice area; the location, size and equivalent lengths of pipe, fittings and hose; and the location and size of the storage facility. Information shall be submitted pertaining to the location and function of *detecting devices*, operating devices, auxiliary equipment and electrical circuitry, if used. Sufficient information shall be indicated to identify properly the apparatus and devices used. Any special features shall be adequately explained. (See 780 CMR 903.0.)

912.3 Actuation: Halogenated extinguishing systems shall be automatically actuated and shall also be provided with a manual means of actuation.

912.4 Safety requirements: Where persons will enter or be trapped in atmospheres made hazardous by a halogenated system discharge, warning signs and discharge alarms shall be provided.

912.5 Acceptance tests: All halogenated extinguishing systems shall be tested in accordance with NFiPA 12A and 12B listed in ***Appendix A***. completed system shall be tested for tightness up to the selector valve, and for continuity of piping with free unobstructed flow beyond the selector valve. The labeling of devices with proper designations and instructions shall be checked. Operational tests shall be conducted on all devices except cylinder valves in multicylinder systems. Where conditions prevail that make it difficult to determine adequately the system requirements or design, a suitable discharge test and concentration analysis shall be made.

780 CMR 913.0 WET-CHEMICAL RANGE HOOD EXTINGUISHING SYSTEMS

913.1 General: Wet-chemical extinguishing systems shall be installed in accordance with the provisions of 780 CMR 913.0, and the BOCA Mechanical Code and NFiPA 17A listed in *Appendix A*. The system shall bear the *label* of an *approved agency* and shall be installed in accordance with the manufacturer's installation instructions. A wet-chemical system is a solution of water and potassium-car-bonate-based chemical, potassium-acetate-based chemical or a combination thereof which forms the extinguishing agent.

913.2 Design: The details of the system indicated on the *fire protection construction documents* shall include sufficient information and calculations on the amount of wet chemical; the size, length and arrangement of connected piping; and a description and location of nozzles so that the adequacy of the system can be determined. Information shall be submitted pertaining to the location and function of *detecting devices*, operating devices, auxiliary equipment and electrical circuitry, if used. Sufficient information shall be indicated to identify properly the apparatus and devices used. Any special features shall be adequately explained. (See 780 CMR 903.0.)

913.3 Actuation: Wet-chemical extinguishing systems shall be automatically actuated and shall be provided with a manual means of actuation.

913.4 Safety requirements: Where persons will be exposed to a wet-chemical discharge, warning signs and discharge alarms shall be provided.

913.5 Acceptance tests: All wet-chemical extinguishing systems shall be tested in accordance with NFiPA 17A listed in *Appendix A*. A completed system shall be tested by discharge of wet chemical in sufficient amounts to verify that the system is properly installed and functional. Tests shall include a check of the detection systems, the alarms and the releasing devices, including manual stations, fuel and power shutoff devices and other associated equipment.

913.5.1 Discharge test: All systems shall be tested by a discharge of expellant gas through the piping and nozzles with observations being made of the flow of expellant gas through all nozzles as well as observing for leakage and continuity of piping with free unobstructed flow.

780 CMR 914.0 STANDPIPE SYSTEMS

914.1 General: Standpipe systems shall be designed, installed and maintained in accordance with the provisions of 780 CMR and NFPA-14 listed in *Appendix A*. Where *standpipe systems* are required by 780 CMR, such systems shall be automatic wet systems. Automatic dry and semi-automatic dry *standpipe systems* shall be permitted only in areas subject to freezing. Complete *fire protection construction documents* shall be provided. (See 780 CMR 903.0.)

914.2 Where required: Class I *standpipe systems* shall be installed where required by 780 CMR 914.2.1 through 914.2.11 and shall be located in accordance with the provisions of NFPA 14, listed in *Appendix A*.

914.2.1 Use Group A: In all buildings or structures or portions thereof of Use Group A when:

1. Two or more stories in height of Use Group A-1, A-2, or A-3, and having an occupant load or more than 300; or;
2. Three or more stories in height regardless of the area per floor; or;
3. Having an auditorium seating over 500. Standpipes shall be located one on each side of the auditorium in each tier, one in each mezzanine, one in each tier of dressing rooms, and protecting each property, store and work room; or;
4. Having a stage. Standpipes shall be located on each side of the stage.

Such standpipes shall be not less that 2½-inch diameter, equipped with approved 1½ inch hose station.

914.2.2 Use Group B: In all buildings or structures or portions thereof of Use Group B when:

1. Three or more stories in height, and more than 3,000 square feet in area per floor; or;
2. Four or more stories in height regardless of the area per floor.

914.2.3 Use Group E: In buildings or structures or portions thereof of Use Group E when three or more stories in height regardless of the area per floor or when having a stage or auditorium in accordance with 780 CMR 914.2.1(3) and 914.2.1(4).

914.2.4 Use Group F: In all buildings or structures or portions thereof of Use Group F when:

1. Three or more stories in height, and more than 3,000 square feet in area per floor, or;
2. Four or more stories in height regardless of the area per floor.

914.2.5 Use Group H: In all buildings or structures or portions thereof of Use Group H when:

1. Three or more stories in height, and more than 10,000 square feet in area per floor; or;
2. Four or more stories in height, regardless of the area per floor.

914.2.6 Use Group I: In all buildings or structures or portions thereof of Use Group I, three or more stories in height, regardless of the area per floor.

914.2.7 Use group M: In all buildings or structures or portions thereof of Use Group M when:

1. Three stories or more in height, and more than 3,000 square feet in area per floor, or;
2. Four or more stories in height regardless of the area per floor, or;
3. Classified as a covered mall building within the mall portions (see 780 CMR 4).
4. Classified as a bulk/merchandising warehouse. (See 780 CMR 4.)

914.2.8 Use Group R-1 and R-2: In all buildings or structures or portions thereof of Use Group R-1 and R-2 when:

1. Three or more stories in height and of Use Group R-1 regardless of the area per floor; or;
2. Three or more stories in height and more than 10,000 square feet in area per floor, or;
3. Four or more stories in height regardless of the area per floor.

914.2.9 Use Group S: In all buildings or structures or portions thereof of Use Group S, other than public garages which shall conform to 780 CMR 914.2.10 when:

1. Three or more stories in height of Use Group S-1, and more than 3,000 square feet in area per floor; or;
2. Three or more stories in height, Use Group S-2, and more than 10,000 square feet in area per floor; or;
3. Four or more stories in height of Use Groups S-1 or S-2 regardless of the area per floor.

914.2.10 Use Group U: In all buildings or structures or portions thereof of Use Group U when:

1. Three or more stories in height and more than 10,000 square feet in area per floor; or;
2. Four or more stories in height regardless of the area per floor.

914.2.11 Public Garages: In all Group I and 11 public garages and open parking structures when:

1. More than 10,000 square feet in area per floor; or;
2. More than 7,500 square feet in area per floor and more than **one story** in height; or;
3. More than 5,000 square feet in area per floor, and more than two stories in height; or;
4. More than three stories in height; or;
5. Located in buildings where the upper stories are designed for other uses: or;
6. When located in any story that is more than 50% below grade.

Exception: Standpipe systems can be "Class I Manual Dry Type" as defined by NFPA-14 for open parking structures less than 70' in height.

914.3 Standpipe system piping sizes: The riser piping, supply piping, and the water service piping shall be hydraulically sized in accordance with the provisions of NFPA-14 listed in ***Appendix A***.

Exception: The residual pressure(s) as noted in NFPA-14 are not required to be maintained in buildings less than 70 feet in height which are equipped throughout with an approved automatic fire suppression system. However the system shall be designed to accommodate the outlet pressures and water flows in accordance with NFPA 14 and inlet pressures consistent with local fire department equipment..

914.4 High-rise buildings: All buildings more than 70 feet in height above the mean grade shall have each floor supplied by a minimum of two combination standpipe/sprinkler risers installed in accordance with the requirements of NFPA-14, listed in ***Appendix A***.

914.5 Outlets: Standpipe system outlets shall comply with the provisions for, Class III Systems of NFPA-14 as listed in ***Appendix A***.

914.6 Acceptance Tests: All Standpipe systems shall be tested in accordance with NFPA listed in ***Appendix A***.

914.6.1 Underground Connections: Underground mains and lead-in connections shall be flushed and tested in accordance with NFPA 14 and NFPA 24 listed in ***Appendix A***.

914.7 Standpipe system requirements for buildings under construction or demolition:

914.7.1 General: Standpipes required by 780 CMR 914.7 are to be either temporary or permanent in nature, with or without a water supply, provided, however, that such standpipes conform to the requirements of 780 CMR 914.0 as to number of risers, capacity, outlets and materials.

914.7.2 Buildings under construction or demolition: Standpipe requirements for buildings under construction or demolition shall be in accordance with the provisions of 780 CMR 3305.3 and NFPA 241 as listed in ***Appendix A***.

780 CMR 915.0 FIRE DEPARTMENT CONNECTIONS

915.1 Required: All required water fire-extinguishing and *standpipe systems* shall be provided with a fire department connection in accordance with the applicable NFPA standards. Standpipes in buildings under construction or demolition shall conform to 780 CMR 3305.3 and NFPA 241 listed in *Appendix A*.

Exceptions:
1. *Limited area sprinkler systems* supplied from the domestic water system.
2. Where the local fire department approves a single connection for large diameter hose of at least four inches.
3. An *automatic sprinkler system* with less than 20 *sprinklers*.

915.2 Connections: Fire department connections shall be arranged in such a manner that the attachment to any one water *sprinkler* connection will serve all sprinklers, and the attachment to any one standpipe connection will serve all *standpipes* within the building.

915.3 Location: Fire department connections shall be located and shall be visible on a street front or in a location approved by the fire department. Such connections shall be located so that immediate access is provided to the fire department. Fire department connections shall not be obstructed by fences, brushes, trees, walls or any other similar object.

915.4 Height: Fire department connections shall not be less than 18 inches (457 mm) and not more than 42 inches (1067 mm). in elevation, measured from the ground level to the centerline of the inlets.

915.5 Projection: Where the fire department connection will otherwise project beyond the property line or into the *public way*, a flush-type fire department connection shall be provided.

915.6 Hose thread: Hose thread in the fire department connection shall be uniform with that used by the local fire department.

915.7 Fittings: Fire department inlet connections shall be fitted with check valves, ball drip valves and plugs with chains or frangible caps.

915.8 Signs: A metal sign with raised letters at least one inch (25 mm) in height shall be mounted on all fire department connections serving *sprinklers* or *standpipes*. Such signs shall read "Automatic Sprinklers" or "Standpipe," or both, as applicable.

780 CMR 916.0 YARD HYDRANTS/ UNDERGROUND FIRE MAINS

916.1 Fire hydrants: Fire hydrants and underground fire mains installed on private property shall be located and installed as directed by the fire department. Hydrants shall conform to the standards of the administrative authority of the jurisdiction and the fire department. Hydrants shall not be installed on a water main less than six inches in diameter. Standards of construction shall be in accordance with NFPA 24 as listed in *Appendix A*.

780 CMR 917.0 FIRE PROTECTIVE SIGNALING SYSTEMS

(Fire Alarm System)

917.1 General: Fire protective signaling systems shall be of an approved type and shall be installed in accordance with the provisions of 780 CMR and NFPA 72 listed in *Appendix A*.

917.2 Fire Protection Construction documents: Where a fire protective signaling system is required by 780 CMR, the *fire protection construction documents* shall show the location and number of all alarm-initiating devices and alarm notification appliances, and shall provide a description of all equipment to be used, proposed zoning, a list of auxiliary control functions (i.e., elevator capture), location of the control panel(s) and annunciator(s), and a complete sequence of operation for the system. (Also see 780 CMR 903.0)

917.3 Approval: All devices, combinations of devices, appliances and equipment shall be approved for the fire protective signaling purpose for which such equipment is used.

917.4 Where required: A fire protective signaling system shall be installed and maintained in full operating condition in the locations described in 780 CMR 917.4.1 through 917.4.6.

917.4.1 Use Group A or E: A fire protective signaling system shall be installed and maintained in all occupancies in Use Group A or E.

917.4.1.1 Special requirements – A-2 use: In addition to the requirements specified in 780 CMR 917.4.1, for A-2 use occupancies and where the occupant load is 50 or greater also refer to 780 CMR 917.8.2.3.

917.4.2 Use Group B: A fire protective signaling system shall be installed and maintained in all occupancies in Use Group B where such buildings have occupied floors which are two or more stories above the lowest *level of exit discharge or* which have floors two or more stories below the highest *level of exit discharge*.

917.4.3 Use Group H: A fire protective signaling system shall be installed and maintained in all occupancies in Use Groups H.

917.4.4 Use Group I: A fire protective signaling system shall be installed and maintained in all occupancies in Use Group I.

917.4.5 Use Group R-1: A fire protective signaling system shall be installed and maintained in all occupancies in Use Group R-1.

917.4.6 Use Group R-2: A fire protective signaling system shall be installed and maintained in all occupancies in Use Group R-2 containing 13 or more dwelling units or where any *dwelling unit* is located more than three stories above the lowest *level of exit discharge* or more than one story below the highest *level of exit discharge* of *exits* serving the *dwelling unit.*

917.5 Location: Manual fire alarm boxes shall be located not more than five feet (1524 mm) from the entrance to each *exit.* Manual fire alarm boxes shall be located in each story including basements. In buildings of use group A where a stage is provided, a manual fire alarm box shall be located next to the lighting control panel. For fire alarm systems employing automatic fire detection or water flow devices, at least one manual fire alarm box shall be provided to initiate a fire alarm signal. This manual fire alarm box shall be located where required by the Head of the Fire department or his or her designee.

Exception:

1. In buildings of use group A, assembly occupancy, and where approved by the local fire department, manual fire alarm boxes may be omitted at *exits* and any other required locations, but shall be provided at constantly attended locations such as ticket booths, refreshment facilities, bars, etc. Where the building official determines that it is impractical to have a constantly attended location in an assembly occupancy other than a theater, manual fire alarm boxes shall be provided at each required building *exit.*
2. Except as provided in 917.5, manual fire alarm boxes are not required in an occupancy in Use Group B where the height of the building is 70 feet or less above the lowest level of fire department vehicle access and the building is equipped throughout with an *automatic sprinkler system*, and/or an *automatic fire detection system* or combination thereof, in accordance with 780 CMR 906.0 and 780 CMR 918.0.

917.5.1 Manual fire alarm boxes: The height of the manual fire alarm boxes shall be a minimum of 42 inches (1067 mm) and a maximum of 54 inches (I372 mm) measured vertically, from the floor level to the activating handle or lever of the box. Manual fire alarm boxes shall be red in color. In all occupancies in Use Group I-3, the manual fire alarm boxes shall be permitted to be locked in areas where staff is present whenever such areas are occupied and keys are readily available to unlock the boxes, or the boxes shall be located in a manned staff location which has direct supervision of the sleeping area.

Exception: Where 521 CMR, Architectural Access Board regulations apply, manual fire alarm box height shall be as prescribed in 521 CMR.

917.6 Power supply: The primary and secondary power supply for the fire protective signaling system shall be provided in accordance with NFPA 72 listed in *Appendix A*.

917.7 Wiring: All wiring shall conform to the requirements of NFPA 72 and 527 CMR 12.00: Massachusetts Electrical Code listed in *Appendix A*. Wireless systems utilizing radio frequency transmitting devices shall comply with the special requirements for supervision of low-power wireless systems in NFPA 72 listed in *Appendix A*.

917.7.1 Activation: The alarm notification appliances shall be automatically activated by all of the following where provided:

1. Smoke detectors, other than single- and multiple-station smoke detectors, as required by 780 CMR 919.0;
2. *Sprinkler* water-flow devices;
3. Manual fire alarm boxes; and
4. Other approved types of automatic fire detection devices, extinguishing, or *suppression systems.*

Exceptions:

1. Smoke detectors in an occupancy in Use Group I-3 are permitted to actuate an audible alarm-indicating appliance at a constantly attended location and are not required to activate a general alarm.
2. Audible alarms in buildings of Use Group A with an occupant load greater than 300 persons shall sound only in a constantly attended receiving station within the building for purposes of initiating emergency action. Occupant notification shall be by means of either voice or prerecorded message announcement initiated by the person in the constantly attended receiving station and in accordance with 780 CMR 917.9. In buildings of Use Group A utilizing reduced lighting levels on a regular basis, lights providing normal lighting levels shall be activated simultaneously with the beginning of the voice or prerecorded message announcement. Where the building official determines that it is impractical to have a constantly attended location in an assembly occupancy the fire alarm system shall be arranged to automatically provide prerecorded evacuation instructions.
3. For mixed use group occupancies that contain an A use group the use group A area shall be in accordance with 780 CMR 917.7.1 exception 2.

917.7.1.1 Length of evacuation signal: Automatic deactivation of audible and visible alarms shall not be allowed.

Exception: Automatic deactivation of audible alarms after a period of operation of 15 minutes shall be permitted when approved by the local fire department. Automatic deactivation of audible alarms shall only be permitted when the fire alarm system is supervised in accordance with 780 CMR 923.2 or by an approved auxiliary fire alarm system in accordance with NFPA 72.

917.7.2 Presignal or positive alarm sequence system: Presignal or positive alarm sequence system is installed, 24-hour supervision by trained personnel shall be provided at a location approved by the local fire department, in order that the alarm signal can be actuated in the event of fire or other emergency.

917.7.3 Zones: Each floor shall be zoned separately and a zone shall not exceed 20,000 square feet (1860 m^2). The length of any zone shall not exceed 300 feet (91440 mm) in any direction. A zoning indicator panel and the associated controls shall be provided in a location approved by the local fire department. Where individually addressable alarm initiating devices are used, a single circuit (or pathway) shall not exceed the above size limitations unless the circuit is a Class A circuit, and the style and device loading meets the requirements for proprietary systems as listed in NFPA 72. Where individually addressable alarm initiating devices are logically combined into groups for annunciation purposes, the above zone size limitations shall apply to the group. The local fire department shall approve all zone and point descriptions. The visual zone indication shall lock in until the system is reset and shall not be canceled by the operation of an audible alarm - silencing switch. In buildings that have floors located more than 70 feet above mean grade, a separate zone by floor shall be provided for the following types of alarm-initiating devices where provided:

1. Smoke detectors;
2. *Sprinkler* water-flow devices;
3. Manual fire alarm boxes; and
4. Other approved types of automatic fire detection devices, extinguishing, or *suppression systems.*

Exceptions:

1. *Automatic sprinkler system* zones shall not exceed the area permitted by NFPA 13 listed in *Appendix A*.
2. Duct type smoke detectors shall be separately identified with a remote test/ indicator station. The location of the remote test/indicator shall be approved by the local fire department.

NON-TEXT PAGE

917.8 Alarm notification appliances: Alarm notification appliances of the approved type shall be provided.

917.8.1 Visible alarms: Visible alarm notification appliances shall be provided in accordance with NFPA 72 and 521 CMR in public and common areas of all buildings and areas of buildings housing the hearing impaired and where required by 521CMR. In occupancies in Use Groups I-1 and R-1, all required accessible sleeping rooms and suites plus an additional number of sleeping rooms or suites in accordance with Table 917.8.1 shall be provided with a visible alarm notification appliance, activated by both the in-room smoke detector and the building fire protective signaling system. In hospital intensive care units, special care units and operating rooms, the audible signal need not be sounded; however a visual alarm shall be displayed with an approved device.

917.8.1.1 Visible alarm synchronization: Where more than one visible signal can be viewed from one location the visible signals shall be synchronized.

Table 917.8.1
VISIBLE AND AUDIBLE ALARMS

Number of sleeping rooms or suites	Sleeping rooms or suites with visible and audible alarms
6 to 25	1
26 to 50	2
51 to 75	3
76 to 100	4
101 to 150	5
151 to 200	6
201 to 300	7
301 to 400	8
401 to 500	9
501 to 1,000	2% of total
1,001 and over	20 plus 1 for each 100 over 1,000

917.8.2 Audible alarms: Audible alarm notification appliances shall be provided and shall sound a distinctive sound which shall not be used for any purpose other than that of a fire alarm. The audible alarm notification appliances shall provide a sound pressure level of 15 dBA above the average ambient or 5 dBA above the maximum sound level having a duration of at least 60 seconds (whichever is greater) sound level in every occupied space within the building. The minimum sound pressure levels shall be: 70 dBA in occupancies in Use Groups R and I-1; 90 dBA in mechanical equipment rooms; and 60 dBA in all other use groups. The maximum sound pressure level for audible alarm notification appliances shall be 120 dBA at the minimum hearing distance from the audible appliance.

917.8.2.1 All audible evacuation signals shall have a synchronized three - pulse temporal pattern in accordance with NFPA 72.

917.8.2.2 A-2 Use – entertainment system response: The activation of any fire protection system element (signaling system, detection, sprinklering, *etc.*) shall automatically:

1. Cause immediate illumination of all areas and components of the required means of egress, and additionally;
2. Cause immediate full activation of all other house lighting; and
3. Cause immediate stopping of any and all sounds and visual distractions (public address systems, entertainment and dance lighting, music, *etc.*) that conflict/compete with the fire protective signaling system.

917.9 Voice/alarm signaling system: A voice/alarm signaling system shall be provided where required by other sections of 780 CMR. When activated in accordance with 780 CMR 917.7.1, the voice/alarm signaling system shall automatically sound an alert signal to all occupants within the building on a general or selective basis to the following terminal areas: elevators, elevator lobbies, *corridors*, *exit stairways*, rooms and tenant spaces exceeding 1,000 square feet (93 m^2) in area; *dwelling units* in occupancies in Use Group R-2; and guestrooms or suites in occupancies in Use Group R-1. The *fire command station* shall contain controls to transmit manually an evacuation signal and voice instructions on a selective and all-call basis to the terminal areas indicated herein. The voice/alarm system shall be designed and installed in accordance with the provisions of 780 CMR, 527 CMR and NFPA 72 listed in *Appendix A*.

Exceptions:
1. A distinctive signal in lieu of a voice alarm is permitted in an occupancy in Use Group F or S.
2. Where the head of the fire department or his/her designee determines that partial or selective evacuation is not desired, but rather total evacuation is required, then a distinctive signal, in lieu of a voice alarm, is permitted.

917.9.1 The sequence of operation of the voice alarm signaling system shall be as follows:

1. Sound an alert (pre-signal) tone (the alert tone shall be a 900 hertz tone pulsed to produce one round of code 4 at approximately one second intervals.
2. Activate the recorded message regarding the evacuation procedure. The alarm and communications system shall provide a pre-recorded message to all required areas. The message shall contain the following information. " attention please. The signal tone you have just head indicated a report of an emergency in this building. If your floor evacuation signal sounds after this message, walk to the nearest stairway and leave the floor. While the report is being verified, occupants on other floors should await further instructions."

   This message shall be transmitted three times.

   A female voice shall be used for this message.
3. Activate the evacuation signal on the floor of incident and the next floor above and below (the evacuation signal shall be in accordance with 780 CMR 917.8.2.1

917.10 Acceptance tests: Upon completion of the fire protective signaling system, all alarm notification devices and circuits, alarm indicating appliances and circuits, supervisory-signal initiating devices and circuits, signaling line circuits, and primary and secondary power supplies shall be subjected to a 100% acceptance test in accordance with NFPA 72 listed in *Appendix A* and 780 CMR 903.0.

780 CMR 918.0 AUTOMATIC FIRE DETECTION SYSTEMS (FIRE ALARM SYSTEMS)

918.1 General: Automatic fire detection systems shall be of an approved type and shall be installed in accordance with the provisions of 780 CMR and NFPA 72 listed in *Appendix A*.

918.2 Fire Protection Construction documents: Where an automatic fire detection system is required by 780 CMR, the *fire protection construction documents* shall show the location and number of all *automatic fire detectors* with specifications of the type of fire detector, proposed zoning and a complete sequence of operation for the system. The system shall be installed in accordance with 780 CMR 918.0 and shall be part of and be subject to the requirements of a fire protective signaling system specified in 780 CMR 917.0. (Also see 780 CMR 903.0)

918.3 Approval: All devices, combinations of devices, appliances and equipment shall be approved for the fire signaling purpose for which such equipment is used. The *automatic fire detectors* shall be smoke detectors, except an approved alternative type of detector shall be installed in spaces such as boiler rooms where, during normal operation, products of combustion are present in sufficient quantity to actuate a smoke detector.

918.4 Where required: An *automatic fire detection system* shall be installed and maintained in full operating condition in the locations described in 780 CMR 918.4.1 through 918.4.7.

918.4.1 Use Group A-4: An *automatic fire detection system* shall be installed in all occupancies of use group A-4.

918.4.2 Use Group E: An *automatic fire detection system* shall be installed in all occupancies of use group E.

918.4.3 Use Group I-1: An *automatic fire detection system* shall be installed and maintained in all occupancies in Use Group I-1.

918.4.4 Use Group I-2: An *automatic fire detection system* shall be installed and maintained in all occupancies in Use Group I-2.

Exception: Occupancies that are equipped throughout with an *automatic sprinkler system* in accordance with 780 CMR 906.0 and that comply with 780 CMR 409.0.

918.4.5 Use Group I-3: An *automatic fire detection system* shall be installed and maintained in all resident housing areas of Use Group I-3. Smoke detectors shall be arranged and positioned to prevent damage or tampering provided that the function and speed of detecting a fire is equivalent to that provided by the spacing and arrangement requirements of NFPA 72 listed in *Appendix A*.

918.4.6 Use Group R-1: An automatic fire detection system shall be installed and maintained throughout all occupancies in Use Group R-1 and in accordance with Table 918.

#320

THE COMMONWEALTH OF MASSACHUSETTS
William Francis Galvin
Secretary of the Commonwealth

Notice of Compliance

Regulation Filing *To be completed by filing agency*

CHAPTER NUMBER: 780 CMR 10

CHAPTER TITLE: Means of Egress

AGENCY: Department of Public Safety / Board of Building Regulations and Standards

THIS REGULATION WAS ORIGINALLY ADOPTED AS AN EMERGENCY:

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Local Government Notice on 4/21/04 and 10/18/04, respectively

PUBLIC REVIEW- *M.G.L. c. 30A, §§ 2 and/or 3 requires notice of the hearing or comment period to be filed with the Secretary of the Commonwealth, published in appropriate newspapers, and sent to persons whom specific notice must be given at least 21 days prior to such hearing or comment period.*

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William Francis Galvin
WILLIAM FRANCIS GALVIN
SECRETARY OF THE COMMONWEALTH
DATE 8/26/05 CLERK

TABLE 918
RESIDENTIAL FIRE PROTECTION REQUIREMENTS

Use Group	Number of Units	Unit Occupant Protection	Other Occupant Protection	Standby Power	Manual Stations	Zoned	Provision for Fire Department Notification
R-3	1 or 2	Yes 919.3.2	Note a.	Yes 919.5	N.A.	N.A.	N.A.
R-1	3 to 12	Yes 919.3.1	Yes 918.4.6	Yes 917.6	Yes 917.4.5	N.A.	N.A.
R-2	3 to 12	Yes 919.3.2	Yes 918.4.7	Yes 919.5	Yes 917.4.6	N.A.	N. A.
R-1	13 or more	Yes 919.3.1	Yes 918.4.6	Yes 917.6	Yes 917.4.5	Yes 917.7.3	Yes 923.2
R-2	13 or more	Yes 919.3.2	Yes 918.4.7	Yes 919.5	Yes 917.4.6	Yes 917.7.3	Yes 923.2

Note a: Where common areas exist.

Exceptions:

1. An *automatic fire detection system* is not required in buildings that do not have interior *corridors serv*ing guestrooms or dwelling units and where all guestrooms or dwelling units have a *means of egress* door opening directly to an exterior *exit access* which leads directly to the *exits*.

2. Guest rooms or dwelling units single or multiple station smoke detectors required by 780 CMR 919.3.1 shall also be annunciated by guest room or dwelling unit at a constantly attended location from which the fire protective signaling system is capable of being manually activated. Detector annunciation shall be capable of operation from stand-by battery or be connected to an emergency electrical system. System smoke detectors shall be permitted providing they operate as follows: a. Provide unit occupant notification; b. Annunciate at a constantly attended location from which the fire protective signaling system is capable of being manually activated; c. Does not automatically activate the building notification appliances; d. Does not automatically activate the supervision requirements of 780 CMR 923.2; e. Be capable of operation including the required annunciation from stand-by battery.

3. A system heat detector shall be required within each guest room or *dwelling unit* located not more than six feet from each door way that leads to an interior *corridor* or exit. System heat detectors shall not be required where the guestroom or *dwelling unit* is equipped with residential *sprinklers* that when activated will activate the fire protective signaling system.

918.4.7 Use Group R-2: An *automatic fire detection* system shall be installed and maintained throughout all occupancies in use group R-2 and in accordance with table 918.

Exceptions:

1. An *automatic fire detection system* is not required in buildings that do not have interior *corridors serv*ing guestrooms or *dwelling units* and where all guestrooms or *dwelling units* have a *means of egress* door opening directly to an exterior *exit access* which leads directly to the *exits*.

2. System smoke detectors are not required in guestrooms or *dwelling units*.

3. A system heat detector shall be required within each guest room or *dwelling unit* located not more than six feet from each door way that leads to an interior *corridor* or exit. System heat detectors shall not be required where the guestroom or dwelling unit is equipped with residential sprinklers that, when activated, will activate the fire protective signaling system.

918.5 Sprinklered buildings exception: Buildings equipped throughout with an *automatic sprinkler system* in accordance with 780 CMR 906.2.1 or 780 CMR 906.2.2 are not required to be equipped with an automatic fire detection system, but are required to be equipped with a fire protective signaling system that conforms to 780 CMR 917.0. This exception does not apply to Use Groups I, R-1, R-2, to high-hazard use groups in accordance with 780 CMR 417.5.3, to special amusement buildings in accordance with 780 CMR 413.0, or to single-station smoke detectors as required in 780 CMR 919.3.

918.6 Zones: Zoning shall be provided in accordance with 780 CMR 917.7.3.

918.7 Alarm verification: Alarms activated by smoke detectors required by 780 CMR 918.0 shall be activated by a single smoke detector monitored by an *alarm verification* zone or an approved equivalent method.

918.8 Local control functions: *Automatic fire detectors* utilized for the purpose of performing local control functions shall be a part of a fire protective signaling system. The detector shall, upon actuation, perform the intended function and activate the alarm notification devices or activate a visible and audible supervisory signal at a constantly attended location.

Exception: In buildings not required to be equipped with a fire protective signaling system, the *automatic fire detector shall* be powered by normal electrical service and, upon actuation, perform the intended function. The detectors shall be located in accordance with NFPA 72 listed in ***Appendix A***. This exception does not apply to smoke detectors required for elevator recall.

918.9 Access: Access shall be provided to each detector for periodic inspection, maintenance and testing.

780 CMR 919.0 SINGLE- AND MULTIPLE-STATION SMOKE DETECTORS

919.1 General: Single- and multiple-station smoke detectors shall be of an approved type and shall be installed in accordance with the provisions of 780 CMR and NFPA 72 listed in ***Appendix A***.

919.1.1 A control and associated equipment, single or multiple station alarm devices or any combination thereof shall be permitted to be used as a *household fire warning system* provided that the requirements of NFPA 72 Chapter 2 are met.

919.2 Fire Protection Construction documents: Where single- and multiple station smoke detectors are required by 780 CMR, the *fire protection construction documents* shall show the location and number with specifications of the type of detector. (Also see 780 CMR 903.0.)

919.3 Where required: Single and multiple station smoke detectors or household fire warning systems shall be installed and maintained in full operating condition in the locations described in 780 CMR 919.3.1 through 919.3.3. Any smoke detector located within 20 feet of a kitchen or within 20 feet of a bathroom containing a tub or shower shall be a photo electric type smoke detector.

919.3.1 Use Group R-1: Single and multiple station smoke detectors or household fire warning systems shall be installed and maintained in the following locations in Use Group R- 1:

1. In all sleeping areas;
2. In every room or hallway in the path of the *means of egress* from the sleeping area to the door leading from the guestroom or suite; and
3. In each story within the guestroom or suite, including *basements*.

Exception: For suites or guestrooms or *dwelling unit* with split levels and without an intervening door between the adjacent levels, a smoke detector installed on the upper level shall suffice for the adjacent lower level provided that the lower level is less than one full story below the upper level.

919.3.2 Use Groups R-2, R-3, R-4 and R-5: Single and multiple station smoke detectors or household fire warning systems shall be installed and maintained in all occupancies in Use Groups R-2, R-3, R-4 and R-5 at the following locations:

1. In the immediate vicinity of bedrooms;
2. In all bedrooms; and
3. In each story within a *dwelling unit*, including *basements*.
4. In Residential Units of 1200 sq. ft. or more, Automatic Fire Detectors, in the form of Smoke Detectors shall be provided for each 1200 square feet of area or part thereof;

Exceptions:

1. In *dwelling units* with split levels and without an intervening door between the adjacent levels, a smoke detector installed on the upper level shall suffice for the adjacent lower level provided that the lower level is less than one full story below the upper level.
2. In buildings equipped throughout with an *automatic sprinkler system* installed in accordance with 780 CMR 906.2.1, 906.2.2 or 906.2.3, smoke detectors are not required in bedrooms where the bedrooms are equipped with residential sprinklers.

919.3.3 Use Group I-1: Single and multiple station smoke detectors or household fire warning systems shall be installed and maintained in all sleeping areas in occupancies in Use Group I- 1.

Exception: Where the building is equipped throughout with an automatic detection system in accordance with 780 CMR 918.4.

919.4 Interconnection: Where more than one detector is required to be installed within an individual *dwelling unit* in an occupancy in Use Group R-2 , R-3 or R4, or within an individual guestroom or suite in an occupancy in Use Group R-1, the detectors shall be wired in such a manner that the actuation of one alarm will actuate all of the alarms in the individual unit.

919.5 Battery backup: In addition to the required AC primary power source, required smoke detectors in occupancies in Use Groups R-2, R-3, R-4, R-5 and I-1 shall receive power from a battery when the AC primary power source is interrupted.

Exception: In buildings equipped throughout with an *automatic sprinkler system* installed in accordance with 780 CMR 906.2.1, 906.2.2 or 906.2.3.

919.6 Acceptance testing: When the installation of the detectors is complete, each detector - and all interconnecting wiring for multiple-station detectors shall be subject to a 100% acceptance test in accordance with NFPA 72 listed in ***Appendix A***

780 CMR 920.0 FIRE EXTINGUISHERS

920.1 Approval: Portable fire extinguishers shall bear the label of an *approved agency*, be of an approved type and be installed in a location visible and available to the occupants.

920.2 Where required: A portable fire extinguisher shall be installed in the following locations in accordance with NFiPA 10 listed in ***Appendix A***:

1. In all occupancies in Use Group A-1, A-2, A-3, B, E, I-2, M, R-1 or H;
2. In all areas containing commercial kitchen exhaust hood systems;
3. In all areas where fuel is dispensed;
4. In all areas where a *flammable* or *combustible liquid* is used in the operation of spraying, coating or dipping;
5. In all occupancies in Use Group I-3 at staff locations. Access to portable extinguishers shall be permitted to be locked;
6. On each completed floor of buildings under construction, other than occupancies in Use Group R-3.
7. In any laboratory, shop or other room occupied for similar purposes; and
8. Where required by the fire prevention code listed in ***Appendix A***.

780 CMR 921.0 SMOKE CONTROL SYSTEMS

921.1 General: Smoke control systems required by 780 CMR shall conform to the provisions of 780 CMR 921.0

921.2 Design criteria: The smoke control system shall be designed to keep the smoke layer interface above the highest of either the highest unprotected opening to adjoining spaces, or six feet (1829 mm) above the highest floor level of *exit access* open to the atrium for a period of 20 minutes. The limiting height for the smoke layer interface for *stages* shall be in accordance with 780 CMR 412.3.8.2. The limiting height of the smoke interface above the floor of the space required to be provided with smoke control is Z_{cr}. Provisions shall also be made to provide for smoke removal from the space at a rate of not less than two air changes per hour by means of natural or mechanical *ventilation*.

921.2.1 Passive system: Active smoke control is not required where it is shown that the smoke interface level requirement will be met without operating smoke exhaust.

921.2.1.1 Regular spaces: For spaces with flat ceilings, a constant horizontal cross-sectional area above the smoke layer interface, and an A/H^2 ratio between 0.9 and 14, the following equation shall be used to estimate the height of the interface at 20 minutes

$$Z = 0.67H - 0.28H \ln\left[\frac{t\,Q^{1/3}H^{4/3}}{A}\right]$$

where:

Z = Height from floor to the smoke interface (feet).

t = Time for interface to descent to Z; Use 1,200 seconds.

H = Height of the space required to be provided with smoke control; floor to flat ceiling (feet).

Q = Steady state heat release rate; Use 4,400 Btu/sec. where the primary use group is M, S-1 or F-1. Otherwise use 2,000 Btu/sec.

A = Horizontal cross-sectional area of the above ceiling space being filled (square feet). Maximum A to be used shall be: $A = 14\,H^2$.

921.2.1.2 Irregular spaces: For spaces with sloped or irregular ceilings, A/H^2 ratios outside the specified range, or varying cross sections, the filling time shall be determined using numerical integration from the ceiling to the critical smoke interface. The following equations shall be used to determine the rate of smoke production:

Where the interface level is above the limiting elevation (z_1) use:

$$V = 17.6Q_c^{1/3}Z^{5/3} + 3.36Q_C$$

Where the interface level is below the limiting elevation (z_1) use:

$$V = 16.64Q_c^{3/5}Z$$

where:

V = The volumetric rate of smoke production (cubic feet per minute).

z_1 = Limiting elevation (ft) = $0.533Q_c^{2/5}$

Qc = The convective portion of the heat release rate shall be estimated as 70 percent of the total heat release rate, Q.

921.2.2 Mechanical systems: Where the smoke filling predicted in 780 CMR 921.2.1 does not meet the design criteria of 780 CMR 921.2, mechanical exhaust shall be provided to maintain these conditions.

921.2.2.1 Exhaust quantities: Sufficient mechanical exhaust shall be provided to maintain the smoke layer interface at or above the critical elevation for the 20-minute period. The volumetric rate of smoke production (V) shall be determined by the equations in 780 CMR 921.2.1.2. If the rate of smoke exhaust is less than the rate of smoke production, the minimum exhaust rate to be supplied for smoke control shall be determined in accordance with Table 921.2.2.1.

Table 921.2.2.1
MINIMUM EXHAUST RATE ADJUSTMENT FACTOR[a]

Z/H	t/t_o					
	Ve/V					
	0.25	0.35	0.50	0.70	0.85	0.95
0.2	1.12	1.19	1.30	1.55	1.89	2.49
0.3	1.14	1.21	1.35	1.63	2.05	2.78
0.4	1.16	1.24	1.40	1.72	2.24	3.15
0.5	1.17	1.28	1.45	1.84	2.48	3.57
0.6	1.20	1.32	1.52	2.00	2.78	4.11
0.7	1.23	1.36	1.61	2.20	3.17	4.98
0.8	1.26	1.41	1.71	2.46	3.71	6.25

Note a. Notation:

Z = Design height of smoke layer interface above fire source.

H = Ceiling height above fire source.

t = Time for smoke layer interface to descend to Z(with exhaust) (seconds).

t_o = Value of t in absence of smoke exhaust (see 780 CMR 921.2.1.1 or 921.2.1.2) (seconds).

V_e = Smoke control exhaust rate (minus any airflow into the smoke layer other than that from the plume).

V = Volumetric smoke production rate (from the equations in 780 CMR 921.2.1.2).

921.2.3 Operation: The smoke control system shall be a dedicated system or shall be integrated with the mechanical *ventilation* system of the building. Operation of the smoke control system shall automatically shut down all systems and devices which interfere with the effective operation of the smoke control system. Where the mechanical *ventilation system* is designed for smoke control, the return air shall be moved directly to the outside without recirculation to other areas of the building.

921.2.4 Alternative systems: An engineered design which will achieve the same level of smoke control as described in 780 CMR 921 is permitted in lieu of these requirements and otherwise in conformance with the requirements of 780 CMR 903.2.1.

921.3 Smoke removal: Provisions shall be made to provide *ventilation* at a rate of at least two air changes per hour from the space required to be provided with smoke control. This *ventilation* shall be through openable vents, separate mechanical exhaust, or through the building mechanical *ventilation* system. The exhaust inlets shall be located a minimum of six feet (1829 mm) above any *exit access* walkway and above any openings into adjoining spaces. The smoke removal system shall be activated by manual controls provided for fire department use unless it is part of the smoke control system.

921.4 Activation: The smoke control system shall be activated by actuation of the following:

1. *Automatic sprinkler system;*
2. Smoke detectors required by 780 CMR 921 that comply with NFPA 72 listed in *Appendix A*; and
3. Manual controls provided for fire department use.

Note: The smoke control system shall not be activated by a manual fire alarm system.

921.4.1 Manual control: Manual controls shall be provided at a location approved by the fire department.

921.4.2 Smoke detector activation: Where the height of the ceiling of the space required to be provided with smoke control exceeds 30 feet (9144 mm) above the floor of the space, approved smoke detectors shall be provided to detect smoke above the highest floor open to an atrium or at the highest point of another space required to be provided with smoke control. The installation of smoke detectors shall comply with 780 CMR 918.0.

921.5 Standby power: All equipment required to provide smoke control in floor openings connecting three or more stories and stage areas in accordance with 780 CMR 412.3.8.2 shall be equipped with a standby source of power that complies with 527 CMR 12.00 as listed in *Appendix A*.

921.6 Acceptance: Any required smoke control design that requires operation of mechanical equipment shall be functionally tested in accordance with 780 CMR 921.6.2 until proper operation of all required mechanical equipment and controls is demonstrated.

921.6.1 System operation report: Prior to acceptance testing, a report of the required system operations shall be provided to the code official. (**NOTE**: also see 780 CMR 903.1.1.1.a., b. and c. The following items shall be included in the report if part of the required system:

1. Identify type(s) of smoke control activation signal(s), such as *sprinkler* waterflow, smoke detection, manual, etc., and associated smoke control system operation(s) that are activated by the signals.
2. Identify *building area(s)* where maximum mechanical exhaust to the outside is implemented and supply air is not provided.
3. Identify *building area(s)* where maximum air supply is implemented and exhaust to the outside is not provided.
4. Identify fan(s) which shall be "On" as required to implement the smoke control system. If multiple speed fans are used, the capacity at which the fans shall operate in the smoke control mode shall be identified.
5. Identify fan(s) which shall be "Off" as required to implement the smoke control system.
6. Identify damper(s) which shall be "Open" to implement the smoke control system.
7. Identify damper(s) which shall be "Closed" to implement the smoke control system.

8. Identify other functions required to implement the smoke control system.
9. Identify *building areas* with smoke and heat vents and method of operation of vents.
10. If required, identify the type(s) of standby power and the equipment that is served.

921.6.2 Testing procedures: The acceptance test procedure shall be approved. Acceptance testing shall be conducted in the presence of the Building official and fire official or their designees or shall include documentation indicating that all mechanical equipment, control sequences, devices and components have been operationally tested and are functioning properly in accordance with the system operation report. Such documentation provided by a *registered professional engineer* or other legally recognized professional (M.G.L. c. 112, § 81R). All documentation from operational testing shall be available for inspection. Acceptance testing shall include the following:

1. Prior to beginning acceptance testing, all building smoke control equipment shall be placed in the normal operating mode.
2. Acceptance testing shall demonstrate that each initiating device, fan, damper and other required equipment is operational and performs to the limits and capacity required.
3. Acceptance testing shall demonstrate that correct control outputs are produced for a given control input for each control sequence specified by the system operation report.
4. If standby power is required for the operation of the smoke control system, acceptance tests shall be conducted while on both normal building power and standby power.
5. Opening of smoke/heat vents shall be demonstrated if the vent is capable of being opened in a manner that does not require destructive testing.

921.7 Elevators: Except when otherwise required by 524 CMR, where buildings are equipped with a mechanical smoke control system that will restrict smoke and hot gases from entering the elevator shaft in the fire floor, hoistway venting is not required. In high-rise buildings equipped with this system and equipped throughout with an automatic fire suppression system, the one-hour fireresistance rated elevator lobby as specified in 780 CMR 403.8 is not required.

780 CMR 922.0 SMOKE AND HEAT VENTS

922.1 General: Where *exit access* travel distance is increased in accordance with 780 CMR 1006.5.1, smoke and heat vents shall be constructed and installed in accordance with 780 CMR 922.0.

922.2 Vent size and spacing: The vent area and the spacing of the vents shall comply with Table 922.2.

922.2.1 Releasing devices: Smoke and heat vents shall open automatically by activation of a heat-responsive device rated at 100°F (38°C) to 220°F (104°C) above ambient. The releasing mechanism shall be capable of operation such that the vent shall fully open when the vent is exposed to a time-temperature gradient that reaches an air temperature of 500°F (260°C) within five minutes. Vents shall be capable of being opened by an approved manual operation.

922.3 Curtain board construction: Curtain boards shall be provided to subdivide a vented building. Curtain boards shall be constructed of material that will resist the passage of smoke and is consistent with the building type of construction. Curtain board location and depth shall comply with Table 922.2. The bottom of the curtain board shall be level.

Table 922.2
SMOKE AND HEAT VENT SIZE AND SPACING[b]

Use Group	Hazard classsification of contents[a]	Vent height above the floor, *H* (feet)	Minimum curtain board depth from vent bottom (feet)	Maximum area formed by curtain boards (square feet)	Vent area to floor area ratio	Maximum spacing of vent centers (feet)	Maximum distance from wall of curtain boards (feet)	Maximum distance between curtain boards
F-1	-	-	0.2XH but ≥4	50,000	1:100	120	60	8 X H but ≤250 feet
S-1	I through IV	20 or less	6	10,000	1:100	100	60	8 X H
S-1	I through IV	Over 20 to 40	6	8,000	1:75	100	55	8 X H but ≤250 feet
S-1	I through IV	20 or less	4	3,000	1:75	100	55	8 X H
S-1	I through IV	Over 20 to 40	4	3,000	1:50	100	50	8 X H but ≤250 feet
S-1	V	20 or less	6	6,000	1:50	100	50	8 X H
S-1	V	Over 20 to 30	6	6,000	1:40	90	45	8 X H
S-1	V	30 or more	4	2,000	1:30	75	40	8 X H but ≤100 feet

Note a. See NFiPA 231 C listed in *Appendix A* for classification of Contents Class I through IV Class V commodities are products that present special fire hazards beyond those of Class I, II, III or IV, such as aerosols, foam plastic, PVC, PU, PS and asphalt paper.
Note b. 1 foot = 304.8 mm; 1 square foot = 0.093 m .

780 CMR 923.0 SUPERVISION

923.1 Fire suppression systems: All *automatic fire suppression systems* required by 780 CMR shall be supervised by one of the following methods below.

1. A *UL listed or FM approved Central Station Service* in accordance with NFPA 72 listed in ***Appendix A***.
2. a. Approved *proprietary supervising station system*, in accordance with NFPA 72 in accordance with NFPA 72 as listed in *Appendic A*.
   b. Approved remote *station fire alarm system supervising station* in accordance with NFPA 72 as listed in ***Appendix A***.
3. Alarm signals to an approved Auxiliary Fire Alarm System in accordance with NFPA 72, with supervisory signals supervised by one or two above or at a constantly attended location approved by the local fire department, having personnel on duty trained to recognize the type of signal received and to take prescribed action. This shall be permitted to be a location different from that at which alarm signals are received.

Exceptions:
1. Underground gate valves with roadway boxes.
2. Halogenated extinguishing systems that are not an integral part of a required *automatic fire suppression system.*
3. Carbon dioxide extinguishing systems that are not an integral part of a required *automatic fire suppression system.*
4. Dry- and wet-chemical extinguishing systems.
5. *Limited area sprinkler systems* (see 780 CMR 907.0).
6. Occupancies in Use Group R complying with 780 CMR 906.2.2 and supervised in accordance with NFPA 13R listed in ***Appendix A***.

923.1.1 Re-transmission of alarm signals received by central stations: In all cases, central stations shall re-transmit alarm signals within 90 seconds of receipt, to the fire department having jurisdiction.

923.2 Fire protective signaling systems and automatic fire detection systems: All *fire protective signaling systems* and automatic fire detection systems required by 780 CMR shall be supervised by one of the following methods below:

1. A *UL listed or FM approved Central Station Service* in accordance with NFPA 72 listed in ***Appendix A***.
2. a. Approved *proprietary supervising station system*, in accordance with NFPA 72 in accordance with NFPA 72 as listed in *Appendic A.*
   b. Approved remote *station fire alarm system supervising station* in accordance with NFPA 72 as listed in ***Appendix A***.
3. Alarm signals to an approved Auxiliary Fire Alarm System in accordance with NFPA 72, with supervisory signals supervised by one or two above or at a constantly attended location approved by the local fire department, having personnel on duty trained to recognize the type of signal received and to take prescribed action. This shall be permitted to be a location different from that at which alarm signals are received.

Exceptions:
1. *For use group R see table 918*
2. Single- and multiple-station detectors as required by 780 CMR 919.0.
3. Smoke detectors in occupancies in Use Group I-3 (see 780 CMR 917.7.1).
4. Smoke detectors in patient sleeping rooms in occupancies in Use Group 1-2 (see 780 CMR 409.5.1).
5. Fire protective signaling systems in occupancies in Use Groups H.

923.2.1 Re-transmission of alarm signals received by central stations: In all cases, central stations shall re-transmit alarm signals within 90 seconds of receipt, to the fire department having jurisdiction.

780 CMR 924.0 FIRE PUMPS

924.1 General: Where fire pumps are required to be installed as part of a required or non-required system(s), the fire pump(s) shall be designed and installed in accordance with 527 CMR 12.00 and NFPA 20 as listed in ***Appendix A***.

924.2 Rooms: Fire pumps and all related equipment shall be located in a dedicated room meeting the physical and environmental features of NFPA 20 listed in ***Appendix A***, and enclosed with not less than two hours fire resistive construction. Fire pumps rooms shall have either direct access to the room from grade or access by a two hour rated passageway and shall be properly secured from unauthorized entry.

924.3 Emergency power: All fire pumps shall be provided with emergency power when installed in the following types of buildings or use groups. Emergency power equipment installation shall conform to 527 CMR 12.00 and NFPA 20 as listed in ***Appendix A***.

1. High-rise buildings as defined by M.G.L. c. 148 § 26A and 780 CMR.
2. Buildings and structures of Use Group A, with a total occupant load of more than 300 occupants.
3. Buildings and structures of Use Group E, with a total occupant load of more than 300 occupants.
4. Buildings and structures of Use Group H.
5. Buildings and structures of Use Group I, having surgery or treatment areas.

NON-TEXT PAGE

CHAPTER 10

MEANS OF EGRESS

780 CMR 1001.0 GENERAL

1001.1 Scope: The provisions of 780 CMR 10 shall control the design, construction and arrangement of building elements required to provide a reasonably safe *means of egress* from all structures.

1001.2 Modification of egress requirements: Where strict compliance with the provisions of 780 CMR is not practical, the code official shall approve alternative *means of egress* which will accomplish the same purpose, by the procedure established in 780 CMR 1 for modification of 780 CMR, or by adoption of *approved rules*.

1001.3 Minimum requirements: It shall be unlawful to *alter* any building or structure in any manner that will reduce the number of *exits* or the capacity of *exits* below the requirements of 780 CMR for new buildings of the proposed occupancy.

780 CMR 1002.0 DEFINITIONS

1002.1 General: The following words and terms shall, for the purposes of 780 CMR 10 and as used elsewhere in 780 CMR, have the meanings shown herein.

Aisle accessway: That portion of an *exit access* which provides a path of travel to an aisle (see 780 CMR 1012.0).

Alternating tread stairway: A stair that has a series of steps between 50° and 70° (0.87 and 1.22 rad) from horizontal, usually attached to a center support rail in an alternating manner so that the user of the stairs never has both feet on the same level at the same time (see 780 CMR 1014.6.6).

Bleachers: A *grandstand* where the seats are not provided with backrests (see 780 CMR 1013.0.)

Common path of travel: That portion of *exit access* which the occupants are required to traverse before two separate and distinct paths of travel to two *exits* are available. Paths that merge are common paths of travel. A common path of travel is measured the same as travel distance but terminates at that point where two separate and distinct routes become available (see 780 CMR 1011.2.1).

Corridor: An enclosed passageway which limits the *means of egress* to a single path of travel (see 780 CMR 1011.0).

Exit: That portion of a *means of egress* which is separated from all other spaces of a building or structure by construction and opening protectives as required for exits to provide a protected way of travel to the *exit discharge* (see 780 CMR 1006.0). Exits include exterior exit doors, exit *stairways* (see 780 CMR 1014.0 and 1015.0), exit passageways (see 780 CMR 1020.0) and *horizontal* exits (see 780 CMR 1019.0).

Exit access: Exit access is that portion of a *means of egress* which leads to an entrance to an *exit* (see 780 CMR 1011.0).

Exit discharge: That portion of a *means of egress* between the termination of an *exit* and a *public way* (see 780 CMR 1006.3).

Exit discharge, level of: The horizontal plane located by the point at which an *exit* terminates and an *exit discharge* begins (see 780 CMR 1006.3.1).

Exit, horizontal: A way of passage from one building to an area of refuge in another building on approximately the same level, or a way of passage through or around a *wall* or partition to an area of refuge on approximately the same level in the same building, which affords safety from fire or smoke from the area of incidence and areas communicating therewith (see 780 CMR 1019.0).

Floor area, gross: Gross floor area shall be the floor area within the perimeter of the outside walls of the building under consideration, without deduction for hallways, stairs, closets, thickness of walls, columns or other features (see 780 CMR 1008.0).

Floor area, net: To determine the number of persons for whom *exits* are to be provided, the net floor area shall be the actual occupied area and shall not include unoccupied accessory areas or thickness of walls (see 780 CMR 1008.0).

Grade hallway, grade lobby, grade passageway: An enclosed hallway or *corridor* that is an element of an *exit*; and terminates at a street or an open space or *court* communicating with a street (see 780 CMR 1020.0).

Grandstand: A structure providing tiered or stepped seating (see 780 CMR 1013.0).

Means of egress: A continuous and unobstructed path of travel from any point in a building or structure to a *public way*. A means of egress consists of three separate and distinct parts: the *exit access*; the *exit*; and the *exit discharge*. A means of egress comprises the vertical and horizontal means of travel and shall include intervening room spaces, doors, hallways, *corridors*, passageways, balconies, ramps, stairs, enclosures, lobbies, *horizontal exits*, *courts* and yards (see 780 CMR 1006.0).

Occupant load: The total number of persons that are permitted to occupy a building or portion thereof at any one time (see 780 CMR 1008.0).

Public way: Any street, alley or other parcel of land open to the outside air leading to a public street, which has been deeded, dedicated or otherwise permanently appropriated to the public for public use and which has a clear width and height of not less than ten feet (3048 mm).

Slidescape: A straight or spiral chute, erected on the interior or exterior of a building, which is designed as a *means of egress* direct to a street or other *public way* (see 780 CMR 1026.0).

Smokeproof enclosure: An enclosed *stairway*, with access from the floor *area* of the building either through outside balconies or ventilated vestibules, opening on a street, yard or open *court*; and with a separately enclosed direct *exit* to the street at the grade floor (see 780 CMR 1015.0).

Stairway: One or more flights of stairs, and the necessary landings and platforms connecting them, to form a continuous and uninterrupted passage from one floor to another (see 780 CMR 1014.0).

Winder: A step in a winding stairway (see 780 CMR 1014.6.3).

780 CMR 1003.0 CONSTRUCTION DOCUMENTS

1003.1 Arrangement of egress: The *construction documents* shall show in sufficient detail the location, construction, size and character of all *exits*, together with the arrangement of *aisles*, *corridors*, passageways and hallways leading thereto in compliance with the provisions of 780 CMR.

1003.2 Number of occupants: In other than occupancies in Use Groups R-2, R-3 and I-1, the *construction documents* and the application for a permit shall designate the number of occupants to be accommodated on every floor, and in all rooms and spaces as required by the code official. Unless otherwise specified, the minimum number of occupants to be accommodated by the *exits* shall be determined by the occupant load prescribed in 780 CMR 1008.0. The posted occupant load of the building shall be limited to that number. The fire prevention code official shall be informed in *writing* of the calculated occupant load.

1003.3 Posted occupant load: Every assembly room or space in an assembly occupancy shall have the approved occupant load of the room or space posted in a conspicuous place, near the main entrance to the room or space. Rooms or spaces which have multiple-use capabilities shall be posted for all such occupancies. All posted signs shall be of an approved legible permanent design.

780 CMR 1004.0 USE GROUP AND OCCUPANCY REQUIREMENTS

1004.1 New buildings: Every building and structure, and part thereof, hereafter erected shall have the prescribed number of *exits* of one or more of the approved types defined in 780 CMR 10. *Exits*, in combination with the *exit access* and *exit discharge*, shall provide safe and continuous *means of egress* to a street or to an open space with direct access to a street.

1004.2 ***Hazardous Means of Egress***:

1004.2.1 Exit Order/Hazardous ***Means of Egress***: In any *existing building* or structure not provided with exit facilities as herein prescribed for new buildings and in which the exits are deemed hazardous or dangerous to life and limb, the *building official* shall declare such building dangerous and unsafe in accordance with the provisions of 780 CMR 121.0.

1004.2.2 Appeal from exit order: Any person served with any order pursuant to 780 CMR 3400.5 shall have the remedy prescribed in 780 CMR 121.

1004.3 Multiple occupancies: Where a building is occupied by two or more occupancies, the *means of egress* requirements shall apply to each portion of the building based on the occupancy of space.

1004.4 Multiple tenants: Where more than one tenant occupies any one floor of a building or structure, each tenant shall be provided with direct access to approved *exits*.

780 CMR 1005.0 GENERAL LIMITATIONS

1005.1 Exits: An *exit* shall not be utilized for any purpose that interferes with its function as a *means of egress*.

1005.2 Floor openings: Manholes or floor access panels which reduce the clearance to less than 32 inches (813 mm) shall not be located in the line of *means of egress*.

1005.3 Protruding objects: A minimum headroom of 80 inches (2032 mm) shall be provided for any walking surface, including walks, halls, *corridors*, aisles and passageways. Structural elements, fixtures or furnishings shall not project from either side more than four inches (102 mm) over any walking surface between the heights of 27 (686 mm) and 80 inches (2032 mm) above the walking surface. A free-standing object mounted on a post(s) or pylon(s) shall not overhang that post(s) or pylon(s) more than 12 inches (305 mm) where the lowest point of the leading edge is more than 27 inches (686 mm) and less than 80 inches (2032 mm) above the walking surface. Door closers and stops shall not reduce headroom to less than 78 inches (1981 mm).

1005.4 Floor surface: All floors of *corridors* and lines of *means of egress* shall have a slip-resistant surface.

1005.5 Open-sided floor areas: Guards shall be located along open-sided walking surfaces, *mezzanines* and landings which are located more than 30 inches (762 mm) above the floor or grade below. The guards shall be constructed in accordance with 780 CMR 1021.0.

Exception: Guards are not required on the loading side of loading docks and the auditorium side of *stages* and raised platforms.

1005.6 Elevation change: Where changes in elevation exist in *exit access corridors*, *exits* or *exit discharge*, ramps shall be used where the difference in elevation is less than 12 inches (305 mm).

Exception: A maximum step height of eight inches (203 mm) shall be permitted for buildings with occupancies in Use Groups F, H, R and S at exterior doors not required to be accessible by ***521 CMR, the Rules and Regulations of the Architectural Access Board, referenced in 780 CMR 11, and listed in Appendix A.***

1005.7 Egress elements for air movement: *Exits* and *exit access corridors* shall not be used as supply or return air ducts or plenums.

Exceptions:

1. The restriction on the use of the space between the *corridor* ceiling and the floor or roof structure above as a return air plenum shall not apply where the *corridor* is not required to be of fireresistance rated construction or is separated from the plenum by fireresistance rated construction or is located within a *dwelling unit*.
2. This restriction shall not apply to *exit access corridors* located within tenant spaces that are 1,000 square feet (92 m^2) or less in area.

780 CMR 1006.0 TYPES AND LOCATION OF MEANS OF EGRESS

1006.1 General: All approved *means of egress*, including doorways, passageways, *corridors*, interior *stairways*, exterior *stairways*, *smokeproof enclosures*, ramps, *horizontal exits*, bridges, balconies, fire escapes and combinations thereof, shall be arranged and constructed as provided for in 780 CMR.

1006.2 Arrangement: All required *exits* shall be so located as to be discernable with unobstructed access thereto.

1006.2.1 Egress through adjoining spaces: Egress from a room or space shall not open into an adjoining or intervening room or area, except where such adjoining room or area is accessory to the area served, is not a high-hazard occupancy and provides a direct *means of egress* to an *exit*. A maximum of one *exit access* shall be permitted to pass through a kitchen, storeroom, restroom, closet or similar space provided that passage through such space is not the only means of access to an *exit*. An *exit access* shall not pass through a room subject to locking. *Means of egress* from *dwelling units*, rooming units, guestrooms and *dormitory* units shall not lead through other such units, or through toilet rooms or bathrooms.

1006.2.2 Assembly buildings: All buildings occupied for assembly purposes shall front on at least one street on which the main entrance and *exit discharge* shall be located. Where there is a single main entrance, the entrance shall be capable of serving as the main *exit* and shall provide an egress capacity for at least one-half of the total occupant load. In addition to having access to a main *exit*, each level of an occupancy in Use Group A shall be provided with additional *exits* which shall provide a *means of egress* capacity for at least one-half of the total occupant load served by that level.

1006.2.2.1 Assembly A-2 minimum main entrance/exit door size: The main entrance/ exit door shall be a minimum 72 inches (nominal) width. This main entrance/ exit door shall consist of a pair of side-hinged swinging type doors without a center mullion and shall be equipped with panic hardware – also see 780 CMR 1011.3.

1006.2.3 Skating rinks: Places of assembly used for skating rinks shall not be located below the floor nearest grade.

1006.2.4 Foyers and waiting spaces: The term "foyer" shall mean an enclosed space surrounding, or in the rear of, the auditorium of a theater or other place of assembly which is completely separated from the auditorium and is used as an assembly or waiting space for the occupants. In

Use Group A-1, a foyer, waiting space or lobby shall be provided with a *net floor area*, exclusive of stairs or landings, of not less than 1½ square feet (0.14 m^2) for each occupant having access thereto. The use of foyers and lobbies and other available spaces for harboring occupants until seats become available shall not encroach upon the clear floor area herein prescribed or upon the required clear width of front *exits*.

1006.2.4.1 Egress: Where the foyer is not directly connected to the public street through the main lobby, an unobstructed *corridor* or passage shall be provided which leads to, and equals the required minimum width of, main entrances and *exits*. A mirror shall not be placed so as to give the appearance of a doorway, *exit* or passageway.

1006.2.4.2 Gradient: The rear foyer shall be at the same level as the back of the auditorium and the *means of egress* leading therefrom shall not have a steeper gradient than one unit vertical in eight units horizontal (1:8).

1006.2.4.3 Construction: In occupancies in Use Group A-1, other than motion picture theaters, the *fire separation assemblies* separating the foyer from the auditorium and other adjoining rooms and spaces shall be constructed with not less than a two-hour fire-resistance rating. Where opening protectives are constructed of noncombustible materials, a fireresistance rating of the opening protectives is not required.

1006.3 Exit Discharge: All *exits* shall discharge directly at a *public way* or at a yard, *court* or open space of the required width and size to provide all occupants with a safe access to a *public way*.

1006.3.1 Level of exit discharge protection: In all buildings having habitable or occupiable stories or *basements* below grade, the floor/ceiling assemblies and supports which are constructed below the *level of exit discharge* shall provide a fireresistance rating of not less than one hour.

Exceptions:

1. Occupancies in Use Group R-3.
2. Buildings of Type 1 construction.
3. Where floor/ceiling assemblies and supports are constructed of Type 4 construction.
4. Where the floor areas below the *level of exit discharge* are equipped throughout with an *automatic sprinkler system* in accordance with 780 CMR 906.2.1 or 906.2.2.
5. Occupiable stories or *basements* below grade which have *exits* that discharge directly to grade.

1006.4 Remote location: Wherever more than one *exit* is required from any room, space or floor of a building, such *exits* shall be placed as remote from each other as practicable, and shall be arranged and constructed to provide direct access in separate directions from any point in the area served so as to minimize the possibility that both *exits* will be blocked by any one fire or other emergency condition.

1006.4.1 Remoteness: Where two *exits* or two *exit access* doors are required, each shall be placed a distance apart equal to not less than one-half of the length of the maximum overall diagonal dimension of the building or area to be served. Where *exit* enclosures are provided as a portion of the required *means of egress* and are interconnected by a *corridor* conforming to the requirements for *corridor* construction, the exit separation distance shall be measured along the line of travel within the *corridor*. In all other cases, the separation distance shall be measured in a straight line between *exits* or *exit access* doors.

Exception: In buildings equipped throughout with an *automatic sprinkler system* in accordance with 780 CMR 906.2.1 or 906.2.2, the minimum separation distance shall be ¼ of the length of the maximum overall diagonal dimension.

1006.4.1.1 Three or more: Where three or more *exits* or *exit access* doors are required, at least two *exits* or *exit access* doors shall be separated as provided for in 780 CMR 1006.4.1.

1006.5 Length of travel: All *exits* shall be so located that the maximum length of *exit access* travel, measured from the most remote point to an approved *exit* along the natural and unobstructed line of travel, shall not exceed the distances given in Table 1006.5.

Table 1006.5

LENGTH OF EXIT ACCESS TRAVEL[a]

Use Group	Without sprinkler system (feet)[c]	With sprinkler system[b] (feet)[c]
A, B, E, F-1, I-1, M, R, S-1	200	250
F-2, S-2	300	400
H-1	25	75
H-2	50	100
H-3	100	150
H-4	125	175
I-2, I-3	150	200

Note a. See the following sections for modification to travel distance requirements.

780 CMR 402.5.1: For the exit access travel distance in malls.

780 CMR 404.7: For the exit access travel distance limitation through an atrium space.

780 CMR 416.6: For the exit access travel distance limitation in HPM use facilities.

780 CMR 1006.5.1: For increased limitation in Use Groups F-1 and S-1.

780 CMR 1006.5.2: For increased limitation in Use Group A-5.
780 CMR 1010.3: For buildings with one exit.
780 CMR 3104.9: For the exit access travel distance limitation in temporary structures.

Note b. Buildings equipped throughout with an automatic sprinkler system in accordance with 780 CMR 906.2.1 or 906.2.2.

Note c. 1 foot = 304.8 mm.

NON-TEXT PAGE

1006.5.1 Roof vent increase: In buildings which are one story in *height*, equipped with automatic heat and smoke roof vents complying with 780 CMR 922.0 and equipped throughout with an *automatic sprinkler system* in accordance with 780 CMR 906.2.1, the *exit access* travel distance limitation in Table 1006.5 for occupancies in Use Group F-1 or S-1 shall be increased to 400 feet (122 m).

1006.5.2 Use Group A-5: Occupancies in Use Group A-5, where all portions of the *means of egress* are essentially open to the outside, shall have an *exit access* travel distance of not more than 400 feet (122 m), except that such occupancies in buildings and structures of Type 1 or 2 construction shall not have an *exit access* travel distance limitation.

1006.6 Elevators, escalators and moving walks: Elevators, *escalators* and *moving walks* shall not be accepted as a required element of the *means of egress*.

Exception: An elevator conforming to 780 CMR 1007.3 shall be permitted for an accessible *means of egress*.

1006.7 Common path of travel: The *common path of exit access travel* distance for occupants to reach a point where two separate and distinct paths of travel are available to two *exits* shall not exceed 100 feet (30480 mm) in occupancies in Use Group I-3.

780 CMR 1007.0 ACCESSIBLE MEANS OF EGRESS

1007.1 General: All spaces required to be accessible by ***521 CMR, the Rules and Regulations of the Architectural Access Board, referenced in 780 CMR 11, and listed in Appendix A*** shall be provided with not less than one accessible *means of egress* that complies with 780 CMR 1007.0. Where more than one *means of egress* is required from any required accessible space, each accessible portion of the space shall be served by not less than two accessible *means of egress*. Each accessible *means of egress* shall provide a continuous path of travel from a required accessible space to a *public way* which is usable by a mobility impaired person and shall include accessible routes, ramps, *exit stairways*, elevators, *horizontal exits* or smoke barriers.

1007.2 Exit stairways: An *exit stairway* to be considered part of an accessible *means of egress* shall have a clear width of at least 48 inches (1219 mm) between handrails and shall either incorporate an area of refuge within an enlarged story-level landing or shall be accessed from an area of refuge complying with 780 CMR 1007.5 or a *horizontal exit*.

Exceptions:

1. Stairs serving a single *dwelling unit* or guestroom.
2. Occupancies equipped throughout with an *automatic sprinkler system* in accordance with 780 CMR 906.2.1.
3. The clear width of 48 inches (1219 mm) between handrails is not required for *exit stairways* accessed from a *horizontal exit*.

1007.3 Elevators: An elevator, to be considered part of an accessible *means of egress*, shall comply with 524 CMR and standby power shall be provided in accordance with 527 CMR 12.00 as listed in *Appendix A*. The elevator shall be accessed from an area of refuge complying with 780 CMR 1007.5 or a *horizontal exit*. In buildings where a required accessible floor is four or more stories above or below a *level of exit discharge* serving that floor, at least one elevator shall be provided and shall serve as one required accessible *means of egress*.

Exceptions:

1. In buildings equipped throughout with an *automatic sprinkler system* in accordance with 780 CMR 906.2.1, the elevator shall not be required to serve floors which are located at or above the *level of exit discharge* and provided with a *horizontal exit* complying with 780 CMR 1019.0.
2. Elevators are not required to be accessed from an area of refuge or a *horizontal exit* in occupancies equipped throughout with an *automatic sprinkler system* in accordance with 780 CMR 906.2.1.

1007.4 Platform lifts: Platform (wheelchair) lifts shall not serve as part of an accessible *means of egress* except within a *dwelling unit*.

1007.5 Areas of refuge: Every required area of refuge shall be accessible from the space it serves by an accessible *means of egress*. The maximum travel distance from any accessible space to an area of refuge shall not exceed the travel distance permitted for the occupancy in accordance with 780 CMR 1006.5. Every required area of refuge shall have direct access to an *exit stairway* complying with 780 CMR 1007.2 or an elevator complying with 780 CMR 1007.3. Where an elevator lobby is used as an area of refuge, the *shaft* and lobby shall comply with 780 CMR 1015.0 for *smokeproof enclosures* except where the elevators are in an area of refuge formed by a *horizontal exit* or smoke barrier.

Exception: Areas of refuge are not required in open parking structures

1007.5.1 Size: Each area of refuge shall be sized to accommodate one wheelchair space of 30 inches (762 mm) by 48 inches (1219 mm) for each 200 occupants or portion thereof, based on the occupant load of the area of refuge and all areas served by the area of refuge. Such wheelchair spaces shall not reduce the required *means of egress* width. Access to any of the required wheelchair spaces in an area of refuge shall not be obstructed by more than one adjoining wheelchair space.

1007.5.2 Separation: Each area of refuge shall be separated from the remainder of the story by a smoke barrier complying with 780 CMR 712.0. Each area of refuge shall be designed to prevent the intrusion of smoke, except those areas of refuge located within a *stairway* enclosure or those areas of refuge where the area of refuge and all areas served by the area of refuge are equipped throughout with an *automatic sprinkler system* in accordance with 780 CMR 906.2.1.

1007.5.3 Communication system: Every area of refuge in buildings more than four stories in height shall be provided with a two-way emergency communication system between the area of refuge and a central control point.

In each area of refuge provided with a two-way emergency communication system, instructions on the use of the area under emergency conditions shall be posted adjoining the communication system. The instructions shall include:

1. Directions to other *means of egress*;
2. Advice that persons able to use the *exit* stairs do so as soon as possible unless they are assisting others;
3. Information on how to summon planned availability of assistance in the use of stairs or supervised operation of elevators; and
4. Directions for use of the two-way emergency communication system.

1007.5.4 Identification: Each door providing access to an area of refuge from an adjacent floor area shall be identified by a sign complying with 521 CMR and CABO A117.4 listed in ***Appendix A*** stating "Area of Refuge" and the International Symbol of Accessibility. The sign shall be illuminated as required for "Exit" signs where "Exit" sign illumination is required. Additionally, tactile signage complying with 521 CMR listed in ***Appendix A*** shall be located at each door to an area of refuge.

1007.6 Signage: Signage indicating the location of accessible *means of egress* shall be installed at all *exits* and elevators that serve a required accessible space, but which are not an approved accessible *means of egress*.

780 CMR 1008.0 OCCUPANT LOAD

1008.1 Design occupant load: In determining required facilities, the number of occupants for whom *exit* facilities shall be provided shall be established by the largest number computed in accordance with 780 CMR 1008.1.1 through 1008.1.3.

1008.1.1 Actual number: The actual number of occupants for whom each occupied space, floor or building is designed.

1008.1.2 Number by Table 1008.1.2: The number of occupants computed at the rate of one occupant per unit of area as prescribed in Table 1008.1.2.

1008.1.3 Number by combination: The number of occupants of any space as computed in 780 CMR 1008.1.1 or 1008.1.2 plus the number of occupants similarly computed for all spaces that discharge through the space in order to gain access to an *exit*.

1008.1.4 Increased occupant load: The occupant load permitted in any building or portion thereof is permitted to be increased from that number established for the occupancies in Table 1008.1.2 provided that all other requirements of 780 CMR are also met based on such modified number. Where required by the code official, an approved aisle, seating or fixed equipment diagram to substantiate any increase in occupant load shall be submitted. Where required by the code official, such diagram shall be *posted*.

Table 1008.1.2
MAXIMUM FLOOR AREA ALLOWANCES PER OCCUPANT

Occupancy	Floor area[a] in square feet per occupant
Assembly with fixed seats	See780 CMR 1008.1.6
Assembly without fixed seats	
Concentrated (chairs only - not fixed)	7 net
Standing space	3 net
Unconcentrated (tables and chairs)	15 net
Bowling centers, allow 5 persons for each lane including 15 feet of runway, and for additional areas	7 net
Business areas	100 gross
Courtrooms - other than fixed seating areas	40 net
Educational	
Classroom area	20 net
Shops and other vocational room areas	50 net
Industrial areas	100 gross
Institutional areas	
Inpatient treatment areas	240 gross
Outpatient areas	100 gross
Sleeping areas	120 gross
Library	
Reading rooms	50 net
Stack area	100 gross
Mercantile, basement and grade floor areas	30 gross
Areas on other floors	60 gross
Storage stock, shipping areas	300 gross

Occupancy	Floor area[a] in square feet per occupant
Parking garages	200 gross
Residential	200 gross
Storage areas, mechanical equipment room	300 gross

Note a. 1 foot = 304.8 mm; 1 square foot = 0.093 m^2

1008.1.5 Maximum occupant load: The occupant load of any space or portion thereof shall not exceed one occupant per three square feet (0.28 m^2) of occupiable floor space.

1008.1.6 Fixed seats: The occupant load for an assembly or educational area having fixed seats shall be determined by the number of fixed seats installed. The capacity of fixed seats without dividing arms shall equal one person per 18 inches (457 mm). For booths, the capacity shall be one person per 24 inches (610 mm).

1008.2 Mezzanine levels: The occupant load of a *mezzanine* level discharging through a floor below shall be added to that floor's occupant load, and the capacity of the *exits* shall be designed for the total occupant load thus established.

1008.3 Roofs: Roof areas occupied as roof gardens or for assembly, educational, storage or other purposes, shall be provided with *exit* facilities to accommodate the required occupant load, but there shall not be less than two approved *means of egress* from roof areas of Use Groups A and E.

780 CMR 1009.0 CAPACITY OF EGRESS COMPONENTS

1009.1 General: The capacity of *means of egress* for a floor, balcony, tier or other occupied space shall be sufficient for the occupant load thereof.

1009.2 Minimum width: The width of each *means of egress* component shall not be less than the width computed in accordance with Table 1009.2 for the required capacity of the component, but not less than the minimum width as prescribed by 780 CMR for each such component.

Table 1009.2
EGRESS WIDTH PER OCCUPANT

Use group	Without sprinkler system (inches per person)[b]		With sprinkler system[a] (inches per person)[b]	
	Stairways	Doors ramps and corridors	Stairways	Doors ramps and corridors
A, B, E, F, M, R, S	0.3	0.2	0.2	0.15
H	0.7	0.4	0.3	0.2
I-1	0.4	0.2	0.2	0.2
I-2	1.0	0.7	0.3	0.2
I-3	0.3	0.2	0.3	0.2

Note a. Buildings equipped throughout with an automatic sprinkler system in accordance with 780 CMR 906.2.1 or 906.2.2.

Note b. 1 inch = 25.4 mm.

1009.3 Exit design per floor: Where *exits* serve more than one floor, only the occupant load of each floor considered individually shall be used in computing the required capacity of the *exits* at that floor, provided that the *exit* capacity shall not decrease in the direction of *means of egress* travel.

1009.4 Egress convergence: Where *means of egress* from floors above and below converge at an intermediate floor, the capacity of the *means of egress* from the point of convergence shall not be less than the sum of the two.

780 CMR 1010.0 NUMBER OF EXITS

1010.1 General: The general requirements of 780 CMR 1010.0 apply to buildings of all use groups. Where more restrictive requirements are provided in 780 CMR, such requirements shall take precedence over the general provisions of 780 CMR 1010.0.

1010.2 Minimum number: Every floor area shall be provided with the minimum number of approved independent *exits* as required by Table 1010.2 based on the occupant load, except as modified in 780 CMR 1010.3.

> **Exception**: In buildings with occupancies in Use Group R having multistory *dwelling units*, the *means of egress* from a *dwelling unit* to the required *exits* is permitted to be provided from one level only. Within the *dwelling unit* access to the *means of egress* from the unit shall conform to the applicable provisions of 780 CMR 10.

Table 1010.2
MINIMUM NUMBER OF EXITS FOR OCCUPANT LOAD

Occupant load	Minimum number of exits
500 or less	2
501 - 1,000	3
over 1,000	4

1010.3 Buildings with one exit: Only one *exit* shall be required in:

1. Occupancies in the use groups shown in Table 1010.3, provided that the building has not more than one level below the *level of exit discharge*.

Table 1010.3
BUILDINGS WITH ONE EXIT

Use Group	Maximum height above grade	Max. Size	Max. Exit access travel distance	Minimum fire-resistance rating of exit enclosure	Min. Fire-resistance rating of opening protection
B[b] S-2[a]	2 stories	3,500 sq. ft. per floor	75 ft.	1 hour	1 hour

Note a. For the required number of exits for open parking structures, see 780 CMR 1010.5.

Note b. For the required number of exits for air traffic control towers, see 780 CMR 414.0.

Note c. 1 foot = 304.8 mm.

1010.4 Emergency escape: Every sleeping room below the fourth story in occupancies in Use Groups R and I-1 shall have at least one operable window or exterior door approved for emergency egress or rescue. The units shall be operable from the inside without the use of special knowledge, separate tools or force greater than that which is required for normal operation of the window. Where windows are provided as a *means of egress* or rescue, the windows shall have the bottom of the clear opening not more than 44 inches (1118 mm) above the floor. All egress or rescue windows from sleeping rooms shall have a minimum net clear opening of 5.7 square feet (0.53 m^2). The minimum net clear opening height dimension shall be 24 inches (610 mm). The minimum net clear opening width dimension shall be 20 inches (508 mm).

Bars, grilles or screens placed over emergency escape windows shall be releasable or removable from the inside without the use of a key, tool or force greater than that which is required for normal operation of the window.

Exceptions:

1. The minimum net clear opening for grade floor windows shall be five square feet (0.47 m^2).
2. An outside window or an exterior door for emergency escape is not required in buildings where the sleeping room is provided with a door to a *corridor* having access to two remote *exits* in opposite directions.
3. An outside window or an exterior door for emergency escape is not required in buildings equipped throughout with an *automatic sprinkler system* in accordance with 780 CMR 906.2.1 or 906 2.2

1010.5 Open parking structures: Parking structures shall not have less than two *exits* from each parking tier, except that only one *exit* is required where vehicles are mechanically parked. Unenclosed vehicle ramps shall not be considered as required *exits* unless pedestrian facilities are provided. Interior *exit stairways* are not required to be enclosed.

780 CMR 1011.0 EXIT ACCESS PASSAGEWAYS AND CORRIDORS

1011.1 Access passageway: Direct *exit access* shall be provided to required *exits* through continuous passageways, *aisle accessways*, aisles or *corridors* which are conveniently available to all occupants and maintained free of obstruction. In every area containing seating, displays, exhibits, counters, shelving and other furnishings or fixtures, a path of travel that connects with each of the *means of egress* doorways serving the area and which complies with the minimum width requirements of aisles, shall be provided.

1011.1.1 Use Groups I-2 and I-3: Every sleeping room in occupancies in Use Group I-2 or I-3 shall have an *exit access* door leading directly to an *exit access* corridor.

Exception: Direct *corridor* access is not required:

1. Where there is an *exit* door opening directly to the outside from the room at ground level.
2. In occupancies in Use Group I-2, where one adjacent room, such as a sitting room or anteroom, intervenes and all doors along the *means of egress* are equipped with nonlockable hardware in accordance with 780 CMR 409.3.2, and the intervening room is not used as an *exit access* for more than eight patients.
3. In occupancies in Use Group I-2, where a patient sleeping room is subdivided with nonfireresistance rated, noncombustible partitions, provided that the arrangement allows for direct and constant visual supervision by nursing personnel and the suite complies with 780 CMR 1011.1 and 780 CMR 1017.0. Such rooms which are so subdivided shall not exceed 5,000 square feet (465 m^2).
4. In occupancies in Use Group I-3, where a dayroom or group activity space intervenes between an in dividual occupant sleeping room and the access to an *exit*, provided that the sleeping room opens directly to the day space and is not separated in elevation by more than one story.

1011.1.2 Turnstiles and gates: Access through turnstiles, gates, rails or similar devices shall not be permitted unless such a device is equipped to swing readily in the direction of *exit* travel under a total force of not more than 15 pounds (73.23 N).

1011.1.3 Restrictions: The required width of passageways, *aisle accessways*, aisles and *corridors* shall be maintained free of projections and restrictions; except that the minimum clear width resulting from doors opening into such spaces shall be one-half of the required width. When fully open, the door shall not project more than seven inches (178 mm) into the required width. Handrail projections are permitted in accordance with 780 CMR 1022.2.1.

1011.2 Dead ends: *exit access* passageways and *corridors* in all stories which serve more than one exit shall provide direct connection to such *exits* in opposite directions from any point in the passageway or *corridor* insofar as practicable. The length of a dead-end passageway or *corridor* shall not be more than 20 feet (6096 mm).

Exceptions:

1. In occupancies in Use Group I-3 of Occupancy Conditions II, III or IV (see 780 CMR 308.4), the dead end in a *corridor*, hallway or aisle shall not exceed 50 feet (15240 mm).
2. In occupancies in Use Group B where passageways are bounded by furniture, counters, partitions or similar dividers not more than six feet (1829 mm) in height, the length of a dead-end passageway shall not be more than 50 feet (15240 mm).
3. Passageways or *corridors* within spaces with one *means of egress*.
4. A dead-end passageway or *corridor* shall not be limited in length where the length of the dead-end passageway or *corridor* is less than 2.5 times the least width of the dead-end passageway or *corridor*.

1011.2.1 Common path of travel: In occupancies in Use Group B, the length of a *common path of travel* shall not exceed 75 feet (22860 mm).

Exceptions:

1. The length of a *common path of travel* in an occupancy in Use Group B shall not be more than 100 feet (30480 mm), provided that the building is equipped throughout with an *automatic sprinkler system* installed in accordance with 780 CMR 906.2.1.
2. Where a tenant space in an occupancy in Use Group B has an occupant load of not more than 30, the length of a *common path of travel* shall not be more than 100 feet (30480 mm).

1011.3 Width: The minimum required width of passageways, *aisle accessways*, aisles and *corridors* shall be determined by the most restrictive of the following criteria:

1. 44 inches (1118 mm) where serving an occupant load of greater than 50.
2. 36 inches (914 mm) where serving an occupant load of 50 or less.
3. 96 inches (2438 mm) in an occupancy in Use Group I-2 used for the movement of beds.
4. 72 inches (1829 mm) in an occupancy in Use Group E with more than 100 occupants.
5. The width required for capacity as determined by 780 CMR 1009.0.
6. At least 72 inches (1829 mm) for the main entrance/exit access in an occupancy in use group A-2 with an occupant load of 50 or more – also see 780 CMR 1006.2.2.1.

Aisles and *aisle accessways* shall conform to the requirements of 780 CMR 1011.0 or 780 CMR 1012.0.

1011.3.1 Capacity: The required capacity of a *corridor* shall be determined by dividing the occupant load that utilizes the *corridor* for *exit access* by the number of *exits* to which the *corridor* connects, but not less than the capacity of the *exit* element to which the *corridor* leads.

1011.4 Enclosure: All *corridors* shall be fireresistance rated in accordance with Table 1011.4 based on the use group of the space and the total required capacity of all of the *exits* from the *corridor*. The *corridor* walls shall comply with 780 CMR 711.0.

Exceptions:

1. A fireresistance rating is not required for *corridors* in an occupancy in Use Group E where each room that is occupied for instruction or assembly purposes has at least one-half of the required *means of egress* doors opening directly to the exterior of the building at ground level.
2. A fireresistance rating is not required for *corridors* contained within a *dwelling unit* or a guestroom in an occupancy in Use Group R.

Table 1011.4
CORRIDOR FIRERESISTANCE RATING

zUse Group	Total required capacity of all exits from corridor	Required fireresistance rating (hours)	
		Without sprinkler system	With sprinkler system[d]
H-1, H-2, H-3	All	1	1
H-4	> 30	1	1
A, B, E, F, M, S	> 30	1	0
I-1, R[a]	> 10	1	½
I-2	All	1	0[b]
I-3	All	Not permitted	0[c]

Note a. For a reduction in the fireresistance rating for occupancies in Use Group R, see 780 CMR 1011.4, Exception 2.

Note b. For requirements for occupancies in Use Group I-2, see 780 CMR 409.3.

Note c. For a reduction in the fireresistance rating for occupancies in Use Group I-3, see 780 CMR 410.7.

Note d. buildings equipped throughout with an automatic sprinkler system in accordance with 780 CMR 906.2.1 or 906.2.2.

1011.4.1 Corridor walls as separation walls: Tenant and *dwelling unit* separation walls which are also *corridor* walls shall comply with 780 CMR 1011.0 and the requirements of Table 602.

Exception: Tenant separation and *dwelling unit* separation walls which are also *corridor* walls shall not be required to have a fireresistance rating greater than that required by Table 1011.4 where the building is equipped throughout with an *automatic sprinkler system* in accordance with 780 CMR 906.2.1 or 906.2.2.

1011.4.2 Opening protectives: All door assemblies from rooms opening onto a *corridor* that is required to be of fireresistance rated construction shall be *fire doors* complying with 780 CMR 716.0.

1011.5 Exterior balconies: Exterior *exit access* balconies shall conform to the requirements of 780 CMR 1011.0 for *corridors* and shall be protected to prevent the accumulation of snow and ice in climates subject to those elements.

1011.5.1 Wall separation: Exterior *exit access* balconies shall be separated from the interior of the building by walls and opening protectives as required by 780 CMR 1011.4. A fireresistance rating for the wall is not required where the balcony is provided with not less than two approved *stairways* or other approved *means of egress* elements and a dead end does not require travel past an unprotected opening for access to the *stairway* or *means of egress* element.

780 CMR 1012.0 ASSEMBLY AISLES AND AISLE ACCESSWAYS

1012.1 Where required: In occupancies in Use Group A which contain seats, tables, displays, equipment or other material shall be provided with *aisle accessways* and aisles in accordance with 780 CMR1012.0. These provisions shall also apply to tiered or stepped seating facilities except as modified by 780 CMR 1013.0.

1012.2 Aisle and aisle accessway width: The width of *aisle accessways* and aisles shall provide sufficient *means of egress* capacity for the number of persons accommodated by the catchment area served by the *aisle accessway* or aisle (see 780 CMR 1012.2.5). The catchment area served by an *aisle accessway* or aisle is the portion of the total space which is naturally served by that section of the *aisle accessway* or aisle. In establishing catchment areas the assumption shall be made that there is a balanced use of all *means of egress*, with the number of persons in proportion to *means of egress* capacity.

1012.2.1 Measurement of required minimum width of aisles and aisle accessways: Where seating is located at a table or counter and is adjacent to an aisle or *aisle accessway*, the measurement of required clear width of the aisle or *aisle accessway* shall be made to a line 19 inches (483 mm) away from the edge of the table or counter. The 19-inch (483 mm) distance shall be measured perpendicular to the side of the table or counter. In the case of other side boundaries for aisles or *aisle accessways* the clear width shall be measured to walls, edges of seating and tread edges, except that handrail projections are permitted.

1012.2.2 Converging aisles and aisle accessways: Where *aisle accessways* or aisles converge to form a single path of *means of egress* travel, the required *means of egress* capacity of such path shall not be less than the combined required capacity of the converging *aisle accessways* or aisles.

1012.2.3 Uniform width of aisles: Those portions of aisles where *means of egress* is possible in either of two directions shall be uniform in required width.

1012.2.4 Uniform width of aisle accessways: Those portions of *aisle accessways* having a required width exceeding 12 inches (305 mm), where *means of egress* is possible in more than one direction, shall be uniform in required width.

1012.2.5 Capacity of aisles and aisle accessways: The width of aisles and *aisle accessways* shall provide sufficient capacity in accordance with the following criteria where clear width is measured in accordance with 780 CMR 1012.2.1.

1. At least 0.3 inch (7.5 mm) of width for each person served shall be provided on stairs having riser heights of seven inches (178 mm) or less and tread depths of 11 inches (279 mm) or greater, measured horizontally between tread nosings.
2. At least 0.005 inch (0.1 mm) of additional stair width for each person shall be provided for each 0.10 inch (2.5 mm) of riser height above seven inches (178 mm).
3. Where a *means of egress* requires stair descent, at least 0.075 inch (2 mm) of additional width for each person shall be provided on those portions of stair width not having handrails within a horizontal distance of 30 inches (762 mm).
4. Level or ramped *means of egress* with slopes less than one unit vertical in eight units horizontal (1:8), shall have at least 0.2 inch (5 mm) of clear width for each person served.

1012.2.6 Minimum width of aisles: The minimum clear width of aisles shall be: 48 inches (1219 mm) for stairs having seating on each side; 36 inches (914 mm) for stairs having seating on only one side; 23 inches (584 mm) between a stair handrail or guardrail and seating where the aisle is subdivided by a handrail (see 780 CMR 1012.5); 42 inches (1067 mm) for level or ramped aisles having theater-style seating on both sides; 36 inches (914 mm) for all other level or ramped aisles; and 23 inches (584 mm) between a stair handrail and seating where an aisle does not serve more than five rows on one side.

1012.2.7 Minimum width of aisle accessways: *Aisle accessways* shall conform to the requirements of 780 CMR 1012.6 in the case of theater-type seating and to the requirements of

780 CMR 1012.7 in the case of all seating at tables or counters.

1012.3 Termination: Each end of a cross aisle shall terminate at an aisle, foyer, doorway or vomitory giving access to an *exit*. Dead-end aisles which terminate only at one end with a cross aisle, foyer, doorway or vomitory giving access to an *exit* shall not be greater than 20 feet (6096 mm) in length.

Exception: A longer dead-end aisle is permitted where seats served by the dead-end aisle are not more than 24 seats from another aisle, measured along a row of seats having a minimum clear width of 12 inches (305 mm) plus 0.6 inch (15 mm) for each additional seat above seven in the row.

1012.4 Walking surfaces: Aisles with a gradient of one unit vertical in eight units horizontal (1:8) or less shall consist of a ramp having a slip-resistant walking surface. Aisles with a gradient exceeding one unit vertical in eight units horizontal (1:8) shall consist of a series of risers and treads which extend across the full width of aisles and comply with 780 CMRs 1012.4.1 and 1012.4.2.

1012.4.1 Treads: Tread depths shall be a minimum of 11 inches (279 mm) and be uniform within each aisle.

Exception: Nonuniformities shall not exceed 3/16 inch (5 mm) between adjacent treads.

1012.4.2 Risers: Where the gradient of aisle stairs is to be the same as the gradient of adjoining seating areas, the riser height shall not be less than 4 inches (102 mm) nor more than eight inches (203 mm) and shall be uniform within each flight.

Exception: Riser height nonuniformity shall be limited to the extent necessitated by changes in the gradient of the adjoining seating area to maintain adequate sightlines. Where nonuniformities exceed 3/16 inch (5 mm) between adjacent risers, the exact location of such nonuniformities shall be indicated with a distinctive marking stripe on each tread at the nosing or leading edge adjacent to the non-uniform risers. Such stripe shall be a minimum of one inch (25 mm) wide and a maximum of two inches (51 mm) wide.

1012.5 Handrails: Ramped aisles having a gradient exceeding one unit vertical in 15 units horizontal (1:15) and aisle stairs shall be provided with handrails located either at the side or within the aisle width.

Exceptions:

1. Handrails are not required if, at the side of the aisle, there is a guardrail that complies with the requirements for handrails.
2. Handrails are not required for *aisles* with seating on both sides unless there is more than one riser per row of seating. The single riser shall be indicated by a distinctive marking stripe on the leading edge of the tread.

1012.5.1 Discontinuous rails: Where there is seating on both sides of the aisle, the handrails shall be discontinuous with gaps or breaks at intervals not exceeding five rows to facilitate access to seating and to permit crossing from one side of the aisle to the other. These gaps or breaks shall have a clear width of at least 22 inches (559 mm) and not greater than 36 inches (914 mm), measured horizontally, and the handrail shall have rounded terminations or bends.

1012.5.2 Intermediate rails: Where handrails are provided in the middle of aisle stairs, there shall be an additional intermediate handrail located approximately 12 inches (305 mm) below the main handrail.

1012.6 Row width: The minimum clear row width shall not be less than 12 inches (305 mm) measured as the clear horizontal distance from the back of the row ahead and the nearest projection of the row behind. Where chairs have automatic or self-rising seats, the measurement shall be made with the seats in the raised position. Where any chair in the row does not have an automatic or self-rising seat, the measurement shall be made with the seat in the down position. Where tablet-arm chair seating is used, the measurement shall be made with the tablet-arm in the usable position.

1012.6.1 Dual access: For rows of seating served by aisles or doorways at both ends, there shall not be more than 100 seats per row. The minimum clear width of 12 inches (305 mm) between rows shall be increased by 0.3 inch (7.5 mm) for every additional seat beyond 14 seats, but the minimum clear width is not required to exceed 22 inches (559 mm).

1012.6.2 Single access: For rows of seating served by an aisle or doorway at only one end of the row, the minimum clear width of 12 inches (305 mm) between rows shall be increased by 0.6 inch (15 mm) for every additional seat beyond seven seats, but the minimum clear width is not required to exceed 22 inches (559 mm). However, the path of travel shall not exceed 30 feet (9144 mm) from any seat to a point where a person has a choice of two paths of travel to two *exits*.

1012.7 Aisle accessways for tables and seating: *Aisle accessways* serving arrangements of seating at tables or counters, shall have sufficient clear width to conform to the capacity requirements of 780 CMR 1012.2.5, but shall not have less than the appropriate minimum clear width specified in 780 CMR 1012.7.1.

1012.7.1 Width: In addition to the width required by 780 CMR 1012.2, *aisle accessways* shall provide a minimum of 12 inches (305 mm) plus 0.5 inch (13 mm) of width for each additional 1 foot (305 mm), or fraction thereof, beyond 12 feet (3660 mm) of *aisle accessway* length measured from the center of the seat farthest from an aisle.

Exception: Portions of an *aisle accessway* having a length not exceeding six feet (1830 mm) and used by a total of not more than four persons.

1012.7.2 Length: The length of travel along the *aisle accessway* shall not exceed 36 feet (10973 mm) from any seat to the closest aisle. The path of travel shall not exceed 30 feet (9144 mm) from any seat to the point where a person has a choice of two or more paths of travel to separate *exits*.

1012.8 Railings: Railings shall be provided on balconies and galleries in accordance with 780 CMR 1021.4.

780 CMR 1013.0 GRANDSTANDS

1013.1 Scope: 780 CMR 1013.0 shall apply to all structures with an occupancy in Use Group A which provide permanent, temporary or portable tiered or stepped seating facilities, such as *grandstands*, *bleachers*, folding and telescopic seating. Except as modified by 780 CMR 1013.0, 780 CMR 1012.0 shall apply to all such structures.

1013.2 Smoke-protected assembly seating: Assembly seating which is served by a *means of egress* that is not subject to blocking by smoke accumulation within or under a structure shall be considered smoke protected and shall comply with the requirements of 780 CMR 1013.2.1 through 1013.2.3.

1013.2.1 Roof height: A smoke-protected assembly seating area with a roof shall have the lowest portion of the roof not less than 15 feet (4572 mm) above the highest aisle or *aisle accessway*.

1013.2.2 Automatic sprinklers: All areas enclosed with walls and ceilings in structures containing smoke-protected assembly seating shall be equipped throughout with an *automatic sprinkler system* in accordance with 780 CMR 906.0.

Exception: An *automatic sprinkler system* is not required for either of the following:

1. The floor area used for a contest, performance or entertainment provided that the roof construction is more than 50 feet (15240 mm) above the floor level and the use of the floor is restricted to low fire-hazard occupancies.
2. Press boxes and storage facilities less than 1,000 square feet (9.3 m^2) in area in conjunction with outdoor seating facilities where all *means of egress* in the seating area are essentially open to the outside.

1013.2.3 Smoke control: All *means of egress* serving a smoke-protected assembly seating area shall be provided with a smoke control system complying with 780 CMR 921.0 or natural *ventilation* designed to maintain the smoke level at least six feet (1829 mm) above the floor of the *means of egress*.

1013.3 Travel distance: The *exit access* travel distance shall comply with 780 CMR 1006.5 except that in a smoke-protected assembly seating area, the travel distance from each seat to the nearest entrance to an egress vomitory portal or egress concourse shall not exceed 200 feet (60960 mm). The travel distance from the entrance to a vomitory portal or egress concourse to an approved egress stair, ramp or walk at the building exterior shall not exceed 200 feet (60960 mm). Where aisles are required, the distance shall be measured along the aisles and *aisle accessways* without travel over or on the seats.

1013.4 Minimum egress widths: The minimum clear width of *stairways*, passageways, doorways, ramps and other *means of egress* shall provide sufficient capacity in accordance with the provisions of 780 CMR 10, except as modified by Table 1013.4.

Table 1013.4
MINIMUM EGRESS WIDTHS SMOKE-PROTECTED ASSEMBLY SEATING

Number of seats in the space	Inches[b] of clear width per seat served			
	Stairs with handrails[a] within 30 inches	Stairs without handrails[a] within 30 inches	Aisles, accessways, doorways and ramps not steeper than 1 in 10 slope	Ramps steeper than 1 in 10 slope
2,000 or less	0.300	0.375	0.200	0.220
5,000	0.200	0.250	0.150	0.165
10,000	0.130	0.163	0.100	0.110
15,000	0.096	0.120	0.070	0.077
20,000	0.076	0.095	0.056	0.066
25,000 or more	0.060	0.075	0.044	0.048

Note a. If risers exceed 7 inches in height, the minimum clear width of stairs determined from the table shall be multiplied by factor A where A = 1 + [(Riser Height - 7.0) ÷ 5].

Note b. 1 inch = 25.4 mm.

1013.5 Aisles: Aisles shall be provided in all seating facilities except that an aisle is not required where all of the following conditions exist.

1. Seats are without backrests.
2. The rise from row to row does not exceed six inches (152 mm) per row.

3. The row spacing does not exceed 28 inches (711 mm) unless the seatboards and footboards are at the same elevation.
4. The number of rows does not exceed 16 in height.
5. The first seatboard is not more than 12 inches (305 mm) above the ground, floor surface or cross aisle below.
6. Seatboards have a continuous flat surface.
7. Seatboards provide a walking surface with a minimum width of 11 inches (279 mm).
8. Egress from seating is not restricted by rails, guards or other obstructions.

1013.5.1 Termination: Where seats are without backrests, dead ends in vertical aisles shall not exceed a distance of 16 rows. For smoke-protected assembly seating, the dead ends in vertical aisles shall not exceed a distance of 21 rows. For smoke-protected assembly seating, a longer dead-end aisle is permitted where seats served by the dead-end aisle are not more than 40 seats from another aisle, measured along a row of seats having an *aisle accessway* with a minimum clear width of 12 inches (305 mm) plus 0.3 inch (8 mm) for each additional seat above seven in the row.

1013.5.2 Row width: For smoke protected assembly seating, the maximum number of seats in a row that has a minimum clear aisle accessway width of 12 inches (305 mm) shall be as specified in Table 1013.5.2.

Where the number of seats per row exceeds that specified in Table 1013.5.2, the minimum clear aisle accessway width for rows served by aisles or doorways at both ends shall be 12 inches (305 mm) plus 0.3 inch (7.5 mm) for every additional seat beyond that specified in Table 1013.5.2 and there shall be not more than 100 seats per row; and for rows served by an aisle or doorway at only one end of the row, the minimum clear *aisle accessway* width shall be 12 inches (305 mm) plus 0.6 inch (15 mm) for every additional seat beyond that specified in Table 1013.5.2.

Table 1013.5.2
ROW LENGTH WITH 12-INCH AISLE ACCESSWAY SMOKE-PROTECTED ASSEMBLY SEATING

Total number of seats in the space	No. Of seats per row permitted to have a minimum 12-inch[a] clear width aisle accessway	
	Aisle or doorway at both ends of row	Aisle or doorway at one end of row
Less than 4,000	14	7
4,000	15	7
7,000	16	8
10,000	17	8
13,000	18	9
16,000	19	9
19,000	20	10
22,000 or more	21	11

Note a. 1 inch = 25.4 mm.

1013.5.3 Single access row: For rows of seating served by an aisle or doorway at only one end of the row in smoke-protected assembly seating, the *common path of travel* from any seat to a point where a person has a choice of two directions of egress travel shall not exceed 50 feet (15240 mm).

1013.6 Bleacher footboards: *Bleacher* footboards shall be provided for all rows of seats above the third row or beginning at such a point where the seatboard is more than two feet (610 mm) above the ground, floor surface or cross aisle below. A separate footboard is not required where the same platform is used for both seating and the footboard, provided that each level or platform is not less than 24 inches (610 mm) wide. On a horizontally projected plane, horizontal gaps between footboards and seatboards shall not exceed ¼ inch (6 mm). Openings between footboards and seatboards which are located more than 30 inches (762 mm) above the floor or grade below shall be provided with intermediate construction such that a sphere with a diameter of four inches (102 mm) cannot pass through the opening.

1013.7 Spaces underneath seats: Spaces underneath *grandstand* seats shall be kept free of all combustible and *flammable* materials and shall not be occupied or used for other than *exits*; except that where enclosed in not less than one-hour fireresistance rated construction, the code official shall approve the use of such spaces for other purposes, provided that the safety of the public is not endangered.

780 CMR 1014.0 STAIRWAYS

1014.1 General: All *stairways* shall comply with the provisions of 780 CMR 1014.0. 780 CMR 1014.11 shall be applicable only to interior *stairways*. 780 CMR 1014.12 shall be applicable only to exterior *stairways*.

1014.1.1 Walking surface: The maximum slope of the walking surface of treads and landings shall be one unit vertical in 48 units horizontal (1:48).

1014.2 Egress capacity: The egress capacity of *stairways* and doors shall be computed in accordance with 780 CMR 1009.0.

1014.3 Width: All *means of egress stairways* shall not be less than 44 inches (1118 mm) in width.

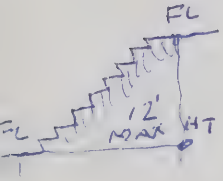
Exceptions:
1. *Stairways* serving buildings of single-exit construction where permitted by 780 CMR 1010.3 shall not be less than 36 inches (914 mm) in width.
2. Spiral *stairways* as provided for in 780 CMR 1014.6.4.

3. *Stairways* serving an occupancy in Use Group R-3 shall not be less than 36 inches (914 mm) in width.
4. *Stairways* serving and contained within a single residential *dwelling unit* shall not be less than 36 inches (914 mm) in width.
5. *Stairways* serving buildings having a total occupant load of 50 or less shall not be less than 36 inches (914 mm) in width.
6. Where a *stairway* lift is installed on *stairways* serving occupancies in Use Group R-3 or within *dwelling units* in occupancies in Use Group R-2, a clear passage width not less than 20 inches (508 mm) shall be provided.

1014.3.1 Restrictions: *Means of egress stairways* shall not reduce in width in the direction of egress travel. Projections into a required *stairway* width are prohibited, except at and below handrail height where, at each handrail, the projections shall not exceed 3½ inches (89 mm) into the required width.

1014.3.2 Landing width: The least dimension of landings and platforms in *means of egress stairways* shall not be less than the required width of the *stairway*, except that the landing dimension in the direction of egress travel is not required to exceed four feet (1219 mm) where the travel from one stair flight to the next stair flight is a straight run.

1014.4 Headroom: The minimum headroom in all parts of a *stairway* shall not be less than 80 inches (2032 mm) measured vertically from the tread nosing or from the floor surface of the landing or platform.



1014.5 Vertical rise: A *means of egress stairway* shall not have a height of vertical rise of more than 12 feet (3658 mm) between landings and intermediate platforms.

1014.6 Treads and risers: Maximum riser height shall be seven inches (178 mm) and minimum riser height shall be four inches (102 mm). Minimum tread depth shall be 11 inches (279 mm), measured horizontally between the vertical planes of the foremost projection of adjacent treads and at a right angle to the tread's leading edge.

Exceptions:
1. Winders in accordance with 780 CMR 1014.6.3.
2. Spiral *stairways* in accordance with 780 CMR 1014.6.4.
3. Circular *stairways* in accordance with 780 CMR 1014.6.5.
4. *Alternating tread stairways* in accordance with 780 CMR 1014.6.6.
5. *Stairways* serving as aisles in assembly seating areas where the *stairway* pitch or slope is set, for sightline reasons, by the slope of the adjacent seating area.
6. Any *stairway* replacing an existing *stairway* within a space where, because of existing construction, the pitch or slope cannot be reduced.
7. Existing *stairways*.
8. In occupancies in Use Group R-3 and within *dwelling units* in occupancies in Use Group R-2, the maximum riser height shall be 8¼ inches (210 mm) and the minimum tread depth shall be nine inches (229 mm). A one-inch (25 mm) nosing shall be provided on *stairways* with solid risers.
9. *Stairways* in penal facilities serving guard towers, observation stations and control rooms not more than 250 square feet (23 m^2) in area shall be permitted to have risers not exceeding eight inches (203 mm) in height and treads not less than nine inches (229 mm) in depth.

1014.6.1 Profile: The radius of curvature at the leading edge of the tread shall not be greater than ½ inch (13 mm). Bevelling of nosings shall not exceed ½ inch (13 mm). Risers shall be solid and vertical or sloped from the underside of the leading edge of the tread above at an angle not more than 30° (0.52 rad) from the vertical. The leading edge of tread shall not project more than 1½ inches (38 mm) beyond the tread below.

Exception: Solid risers are not required for *stairways* serving dwelling units which are not required to be accessible or adaptable in accordance with ***521 CMR, the Rules and Regulations of the Architectural Access Board, referenced in 780 CMR 11, and listed in Appendix A***, provided that the opening between treads does not permit the passage of a sphere with a diameter of four inches (102 mm).

1014.6.2 Dimensional uniformity: There shall not be variation exceeding 3/16 inch (5 mm) in the depth of adjacent treads or in the height of adjacent risers. The tolerance between the largest and smallest riser or between the largest and smallest tread shall not exceed ⅜ inch (10 mm) in any flight of stairs.

Exceptions:
1. Where the bottom riser adjoins a sloping *public way*, walk or driveway which has an established grade and serves as a landing, a variation in the height of the bottom riser shall not exceed three inches (76 mm) in every three feet (914 mm) of *stairway* width.
2. On *stairways* serving as aisles in assembly seating, where necessitated by changes in the gradient of adjoining seating areas to maintain adequate sightlines, the maximum nonuniformity of riser heights within a flight and the nonuniformity between adjacent risers shall not apply. Where a nonuniformity exceeds 3/16 inch (5 mm) between adjacent risers, the exact location of the nonuniformity

shall be indicated with a distinctive marking stripe on each tread at the nosing or leading edge adjacent to the nonuniform risers.

1014.6.3 Winders: Winders shall not be permitted in required *means of egress stairways* except in occupancies in Use Group R-3 and *stairways* serving a single *dwelling unit*. Such winders shall have a tread depth of not less than nine inches (229 mm) at a point not more than 12 inches (305 mm) from the side where the tread is narrower and the minimum tread depth shall not be less than six inches (152 mm).

1014.6.4 Spiral stairways: Spiral *stairways* shall not be used as an element of a *means of egress* except: in occupancies in Use Group R-3; within a single *dwelling unit*; from a *mezzanine* area not more than 250 square feet (23.25 m^2) in area which serves not more than five occupants; and in penal facilities from a guard tower, observation station or control room not more than 250 square feet (23 m^2) in area. The minimum width of all spiral *stairways* shall be 26 inches (660 mm) with each tread having a 7½-inch (191 mm) minimum tread depth at 12 inches (305 mm) from the narrow edge. All treads shall be identical and the rise shall not be more than 9½-inches (241 mm). A minimum headroom of six feet six inches (1981 mm) shall be provided.

1014.6.5 Circular *stairways*: Circular *stairways* shall have a minimum tread depth and a maximum riser height in accordance with 780 CMR 1014.6 and the smaller radius shall not be less than twice the width of the *stairway*. The minimum tread depth measured 12 inches (305 mm) from the narrower end of the tread shall not be less than 11 inches (279 mm).

1014.6.6 Alternating tread stairways: *Alternating tread stairways* are permitted as an element of a *means of egress* in buildings from a *mezzanine* area not more than 250 square feet (23 m^2) in *area* and which serves not more than five occupants; and in penal facilities, from a guard tower, observation station or control room not more than 250 square feet (23 m^2) in area. *Alternating tread stairways* are also permitted for access to roofs as provided for in 780 CMR 1027.0.

1014.6.6.1 Handrails of alternating tread stairways: Handrails shall be provided on both sides of *alternating tread stairways* and shall conform to 780 CMR 1022.0.

1014.6.6.2 Treads of alternating tread stairways: *Alternating tread stairways* shall have a minimum projected tread of five inches (127 mm), a minimum tread depth of 8½ inches (216 mm), a minimum tread width of seven inches (178 mm) and a maximum riser to the next surface of the alternating tread of 9½ inches (241 mm). The initial tread of the *stairway* shall begin at the same elevation as the platform, landing or floor surface.

Exception: *Alternating tread stairways* used as an element of a *means of egress* in buildings from a mezzanine area not more than 250 square feet (23 m^2) in area which serves not more than five occupants shall have a minimum projected tread of 8½ inches (216 mm) with a minimum tread depth of 10½ inches (267 mm). The rise to the next alternating tread surface shall not be more than eight inches (203 mm).

1014.7 Stairway guards and handrails: *Stairways* shall have continuous guards and handrails on both sides. Intermediate handrails are required so that all portions of the required width of stairs are within 30 inches (762 mm) of a handrail. On monumental stairs, handrails shall be located along the most direct path of egress travel. Handrails shall be provided for *alternating tread stairways* in accordance with 780 CMR 1014.6.6.1. Guards shall be constructed in accordance with 780 CMR 1021.0. Handrails shall be constructed in accordance with 780 CMR 1022.0.

Exceptions:

1. *Stairways* with fewer than three risers are not required to have handrails where serving a single *dwelling unit* or where such *stairways* are not in an *exit access corridor* or aisle, *exit* or *exit discharge*.
2. Aisle stairs provided with a center handrail or serving seating on one side shall be equipped with a minimum of one handrail.
3. *Stairways* within a *dwelling unit* shall be equipped with a minimum of one handrail.
4. Spiral *stairways* shall be equipped with a minimum of one handrail.

1014.8 Egress doors: *Means of egress stairway* doors shall provide an egress capacity of not less than the required capacity of the *stairway* which serves the floor or area from which the egress door leads.

1014.8.1 Width: The minimum required width of every door to or from a *means of egress stairway* shall be determined by the most restrictive of the following criteria:

1. 29¾-inch (756 mm) clear width within a *dwelling unit* that is not required to be accessible or adaptable.
2. 36-inch (914 mm) minimum width of door leaf in an occupancy in Use Group I-2.
3. 32-inch (813 mm) clear width in all other cases.

Exception: When applicable for A-2 use groups with an occupant load of 50 or greater also see 780 CMR 1006.2.2.1 and 1011.3

1014.8.2 Direction of swing: All *means of egress* doors shall swing on a landing in the direction of egress travel. When opening, egress doors shall not reduce the width of landings to less than one-half of the required width. When fully open, *means of egress* doors shall not project more than seven inches (178 mm) into the required width.

Exception: Doors leading from a room or tenant space to a *stairway* in buildings in which only one *exit* is required are not required to swing in the direction of egress travel.

1014.8.3 Door construction: All doorway opening protectives shall be *fire doors* complying with 780 CMR 716.0. *Labeled means of egress fire doors* shall have a maximum transmitted temperature end point of not more than 450°F (232°C) above ambient at the end of 30 minutes of standard fire test exposure.

1014.9 Stairway construction: All *stairways* shall be built of materials consistent with the types of materials permitted for the type of construction of the building; except that wood handrails shall be permitted for all types of construction. Such *stairways* shall have solid treads and landing platforms, and all finish floor surfaces shall be of slip-resistant materials.

1014.9.1 Strength: All *stairways*, platforms and landings in other than occupancies in Use Group R-3 shall be adequate to support a *live load* of 100 pounds per square foot (488.20 kg/m^2) and a concentrated *load* of 300 pounds (136.20 kg).

1014.10 Discharge identification: *Exit stairways* which continue beyond the *level of exit discharge* shall be interrupted at the *level of exit discharge* by partitions, doors or other effective means of preventing persons from continuing past the floor of discharge while egressing.

1014.11 Interior stairway enclosures: Interior *exit stairways* shall be enclosed with *fire separation assemblies* having a fireresistance rating of not less than two hours except that such *stairways* in occupancies in Use Group A, B, E, F, H-4, I, M, R or S which connect less than four stories shall be enclosed with *fire separation assemblies* having a fireresistance rating of not less than one hour. An *exit stairway* enclosure shall not be used for any purpose other than *means of egress*. Openings in exit enclosures, other than unexposed exterior openings, shall be limited to those necessary for *exit access* to the enclosure from normally occupied spaces and for egress from the enclosure.

Exceptions:

1. *Stairways* are not required to be enclosed in occupancies in Use Group A-5 in which all portions of the *means of egress* are essentially open to the outside.
2. *Stairways* serving and contained within a single residential *dwelling unit* in occupancies in Use Group R-2 or R-3 are not required to be enclosed.
3. *Stairways* that are not a required *means of egress* element are not required to be enclosed where such *stairways* comply with 780 CMR 713.3.
4. *Stairways* in open parking structures which serve only the parking structure are not required to be encloed.
5. *Stairways* in occupancies in Use Group I-3 as provided for in 780 CMR 410.3.7.

1014.11.1 Exterior walls: Exterior walls of an enclosed *exit stairway* shall comply with the requirements of 780 CMR 705.0 for exterior walls. Where nonrated walls or unprotected openings enclose the exterior of the *stairway*, the building exterior walls within ten feet (3048 mm) horizontally of the nonrated wall or unprotected opening shall be constructed as required for *stairway* enclosures, including opening protectives, but are not required to exceed a one-hour fireresistance rating with ¾-hour opening protectives. This construction shall extend vertically from a point ten feet (3048 mm) above the topmost landing of the *stairway* or to the roof line, whichever is lower, and down to the ground.

1014.11.2 Penetrations: Penetrations into and openings through an *exit* enclosure assembly are prohibited except for required *exit* doors, ductwork and equipment necessary for independent stair pressurization, required *ventilation sprinkler* piping, *standpipes* and electrical conduit serving the *stairway* and terminating at a steel box that does not exceed 16 square inches (10323 mm^2) in area. There shall not be any penetrations or communicating openings, whether protected or not between adjacent *stairway* enclosures.

1014.11.3 Door locks: All interior *stairway means of egress* doors shall be openable from both sides without the use of a key or special knowledge or effort.

Exceptions:

1. *Stairway* discharge doors shall be operable from the egress side and shall only be locked from the opposite side.
2. 780 CMR 1014.0 shall not apply to doors arranged in accordance with 780 CMR 403.10 and 1017.4.

1014.11.4 Exit signs: Each door to an enclosed *exit stairway* shall be equipped with tactile signage reading "Exit" complying with 521 CMR listed in *Appendix A* and installed on the side of the door from which *egress* is to be made.

1014.11.5 Stairway floor number signs: A sign shall be provided at each floor landing in all interior *exit stairways* connecting more than three stories designating the floor level above and below the *level of exit discharge*, the identification of the *stairway* and the availability of roof access from that *stairway*. The sign shall be located approximately five feet (1524 mm) above the floor landing in a position which is readily visible when the doors are in the open and closed positions.

1014.12 Exterior stairways: Exterior *stairways* shall have openings on at least one side facing an *outer court*, yard or *public way*. The openings shall have an aggregate width of not less than 20% of the *stairway* perimeter and an aggregate area on each level of not less than 12% of the total perimeter wall area of each level. In other than occupancies in Use Group R-3, treads, platforms and landings which are part of exterior stairways in climates subject to snow or ice shall be protected to prevent accumulation of same. Exterior *stairways* shall not be accepted as an *exit* in the following cases:

1. Occupancies in Use Groups I-2 and I-3 in buildings that exceed four stories or 50 feet (15240 mm) in *height*.
2. Floors that exceed five stories or 65 feet (19812 mm) in height above the *level of exit discharge*.

1014.12.1 Location: Exterior *exit stairways* shall not project beyond the *street lot line*. Exterior *exit stairways* shall be located at least ten feet (3048 mm) from adjacent *lot lines* and from other buildings on the same lot unless openings in such buildings are protected by ¾-hour opening protectives.

Exception: Noncombustible exterior *stairways* constituting not more than 50% of the required *means of egress* shall be exempt from the ten-foot (3048 mm) *fire separation distance* requirement.

1014.12.2 Protection: Exterior *exit* stairs shall be separated from the interior of the building by walls with a fireresistance rating of not less than one hour, with fixed or self-closing opening protectives as required in 780 CMR 1014.11. This protection shall extend vertically from a point ten feet (3048 mm) above the topmost landing or the roof line, whichever is lower, down to the ground, and shall extend horizontally ten feet (3048 mm) from each side of the *stairway*. Openings within the horizontal ten-foot (3048 mm) extension of the protected walls beyond the *stairway* shall be equipped with fixed ¾-hour opening protective assemblies.

Exceptions:

1. Occupancies, other than those in Use Group R-1 or R-2, in buildings that are two stories or less above grade where the level of *exit discharge* is the first *story above grade*.
2. Separation from the interior of the building is not required where the exterior *stairway* is served by an exterior *exit access* balcony that connects two remote exterior *stairways* or other approved *exits*, with a perimeter which is not less than 50% open. To be considered open, the opening shall be a minimum of 50% of the height of the enclosing wall, with the top of the openings not less than seven feet (2134 mm) above the top of the balcony.
3. Separation from the interior of the building is not required for an exterior *stairway* located in a building or structure that is permitted to have unenclosed interior *exit stairways* in accordance with 780 CMR 1014.11.

780 CMR 1015.0 SMOKEPROOF ENCLOSURES

1015.1 General: A *smokeproof enclosure* shall consist of an enclosed interior *exit stairway* that conforms to 780 CMR 1014.0 and an outside balcony or a *ventilated* vestibule meeting the requirements of 780 CMR 1015.0. Where access to the roof is required by 780 CMR 1027.0, such access shall be from the *smokeproof enclosure* where a *smokeproof enclosure* is required.

1015.2 Where required: In buildings having a height of 70 feet above the grade plane, at least one exit stairwell shall be protected by a smokeproof enclosure serving all floor levels. In buildings having exit stairwells more than 30 feet below the *level of exit discharge*, at least one exit stairwell shall be protected by a smokeproof enclosure serving all floor levels located below the *level of exit discharge*.

Exception: Occupancies in Use Group I-2.

1015.3 Access: Access to the stair shall be from every story and shall be by way of a vestibule or by way of an open exterior balcony. The minimum dimension of the vestibule shall not be less than the required width of the *corridor* leading to the vestibule but shall not have a width of less than 44 inches (1118 mm) and shall not have a length of less than 72 inches (1829 mm) in the direction of egress travel.

1015.4 Construction: The *smokeproof enclosure* shall be separated from the remainder of the building by not less than a two-hour fireresistance rated *fire separation assembly* without openings other than the required *means of egress* doors. The vestibule shall be separated from the *stairway* by not less than a two-hour fireresistance rated *fire separation assembly*. The open exterior balcony shall be constructed in accordance with the fireresistance rating requirements for floor construction.

1015.4.1 Door closers: All doors in a *smokeproof enclosure* shall be self-closing or shall be automatic-closing by actuation of a smoke detector installed at the floor side entrance to the *smokeproof enclosure* in accordance with 780 CMR 716.5. The actuation of the smoke detector on any door shall activate the closing at all levels. Smoke detectors shall be installed in accordance with 780 CMR 918.8.

1015.5 Natural ventilation alternative: The provisions of 780 CMR 1015.5.1 through 1015.5.3 shall apply to *ventilation* of *smokeproof enclosures* by natural means.

1015.5.1 Balcony doors: Where access to the *stairway* is by way of an open exterior balcony, the door assembly into the enclosure shall be a *fire door* in accordance with 780 CMR 716.0.

1015.5.2 Vestibule doors: Where access to the *stairway* is by way of a vestibule, the door assembly into the vestibule shall be a *fire door* complying with 780 CMR 716.0. The door assembly from the vestibule to the *stairway* shall have not less than a 20-minute fire protection rating complying with 780 CMR 716.0.

1015.5.3 Vestibule ventilation: Each vestibule shall have a minimum net area of 16 square feet (1.49 m^2) of opening in a wall facing an *outer court*, yard or *public way* which is at least 20 feet (6096 mm) in width.

1015.6 Mechanical ventilation alternative: The provisions of 780 CMR 1015.6.1 through 1015.6.4 shall apply to *ventilation* of *smokeproof enclosures* by mechanical means.

1015.6.1 Vestibule doors: The door assembly from the building into the vestibule shall be a *fire door* complying with 780 CMR 716.0. The door assembly from the vestibule to the *stairway* shall have not less than a 20-minute fire protection rating in accordance with 780 CMR 716.0. The door from the building into the vestibule shall be provided with gaskets or other provisions to minimize air leakage.

1015.6.2 Vestibule ventilation: The vestibule shall be supplied with not less than one air change per minute, and the exhaust shall not be less than 150% of supply. Supply air shall enter and exhaust air shall discharge from the vestibule through separate, tightly constructed ducts used only for that purpose. Supply air shall enter the vestibule within six inches (152 mm) of the floor level. The top of the exhaust register shall be located at the top of the smoke trap but not more than six inches (152 mm) down from the top of the trap, and shall be entirely within the smoke trap area. Doors in the open position shall not obstruct duct openings. Duct openings with controlling dampers are permitted where necessary to meet the design requirements, but dampers are not otherwise required.

1015.6.2.1 Engineered ventilation system: Where a specially engineered system is used, the systems shall exhaust a quantity of air equal to not less than 90 air changes per hour from any vestibule in the emergency operation mode and shall be sized to handle three vestibules simultaneously. Smoke detectors shall be located at the floor side entrance to each vestibule and shall activate the system for the affected vestibule. Smoke detectors shall be installed in accordance with 780 CMR 918.8.

1015.6.3 Smoke trap: The vestibule ceiling shall be at least 20 inches (508 mm) higher than the door opening into the vestibule to serve as a smoke and heat trap and to provide an upward moving air column. The height shall not be decreased unless approved and justified by design and test.

1015.6.4 Stair shaft air movement system: The stair *shaft* shall be provided with a dampered relief opening and supplied with sufficient air to maintain a minimum positive pressure of 0.10 inch of water column (24.88 P) in the *shaft* relative to the vestibule with all doors closed.

1015.7 Ventilating equipment: The activation of *ventilating* equipment required by the alternatives in 780 CMR 1015.6 shall be by smoke detectors installed at each floor level at an approved location at the entrance to the *smokeproof enclosure*. When the closing device for the stair *shaft* and vestibule doors is activated by smoke detection or power failure, the mechanical equipment shall activate and operate at the required performance levels. Smoke detectors shall be installed in accordance with 780 CMR 918.8.

1015.7.1 Ventilation systems: *Smokeproof enclosure ventilation* systems shall be independent of other building *ventilation* systems. The equipment and ductwork shall comply with one of the following:

1. Equipment and ductwork shall be located exterior to the building and shall be directly connected to the *smokeproof enclosure* or connected to the *smokeproof enclosure* by ductwork enclosed by two-hour fireresistance rated *fire separation assemblies*.
2. Equipment and ductwork shall be located within the *smokeproof enclosure* with intake or exhaust directly from and to the outside or through ductwork enclosed by two-hour fireresistance rated *fire separation assemblies*.
3. Equipment and ductwork shall be located within the building if separated from the remainder of the building, including other mechanical equipment, by two-hour fireresistance rated *fire separation assemblies*.

1015.7.2 Standby power: Mechanical vestibule and stair *shaft ventilation* systems and automatic fire detection systems shall be powered by an approved standby power system conforming to 780 CMR 403.9.1 and ***527 CMR 12.00, the Massachusetts Electrical Code, referenced in 780 CMR 27, and listed in Appendix A***.

NON-TEXT PAGE

1015.7.3 Acceptance and testing: Before the mechanical equipment is approved, the system shall be tested in the code official's presence to confirm that the system is operating in compliance with these requirements.

780 CMR 1016.0 RAMPS

1016.1 Capacity: The capacity of a ramp used as a *means of egress* component shall be computed in accordance with 780 CMR 1009.0.

Note: For ramp design requirements related to building access issues, refer to 780 CMR 11.00

1016.2 Minimum dimensions: The minimum dimensions of *means of egress* ramps shall comply with 780 CMR 1016.2.1 through 1016.2.3.

1016.2.1 Width: The minimum width of a *means of egress* ramp shall not be less than that required for *corridors* by 780 CMR 1011.3.

1016.2.2 Headroom: The minimum headroom in all parts of the *means of egress* ramp shall not be less than 80 inches (2032 mm).

1016.2.3 Restrictions: *Means of egress* ramps shall not reduce in width in the direction of egress travel. Projections into the required ramp and landing width are prohibited except at and below handrail height where, at each handrail, the projections shall not exceed 3½ inches (89 mm) into the required width. Doors opening onto a landing shall not reduce the clear width to less than 42 inches (1067 mm).

1016.3 Maximum slope: The maximum slope of *means of egress* ramps in the direction of travel shall be one unit vertical in 12 units horizontal (1:12); except the maximum slope shall be: one unit vertical in eight units horizontal (1:8) if the rise is limited to three inches (76 mm); one unit vertical in ten units horizontal (1:10) if the rise is limited to six inches (152 mm). The maximum slope across the direction of travel shall be one unit vertical in 48 units horizontal (1:48).

Exception: Aisles in areas of Use Group A shall comply with 780 CMR 1012.0.

1016.4 Landings: Ramp slopes of one unit vertical in 12 units horizontal (1:12) or steeper shall have landings at the top, bottom, all points of turning, entrance, *exit* and at doors. Ramps shall not have a vertical rise greater than 30 inches (762 mm) between landings. The maximum slope of landings shall be one unit vertical in 48 units horizontal (1:48). The least dimension of a landing shall not be less than the required width of the ramp except that the landing dimension in the direction of travel is not required to exceed four feet (1219 mm) where the travel from one ramp to the next ramp is a straight run.

Exception: Aisles in areas of Use Group A shall comply with 780 CMR 1012.0.

1016.5 Guards and handrails: Guards shall be provided on both sides of the ramp and shall be constructed in accordance with 780 CMR 1021.0. Handrails conforming to 780 CMR 1022.0 shall be provided on both sides of every ramp having a slope greater than one unit vertical in 20 units horizontal (1:20). Handrails are not required on ramps where the vertical rise between landings is six inches (152 mm) or less.

Exception: Handrails in aisles in occupancies in Use Group A shall comply with 780 CMR 1012.0.

1016.5.1 Drop-offs: The sides of ramps and landings with a drop-off shall have a curb with a minimum four-inch (102 mm) height above the walking surface or shall be provided with a guardrail.

1016.6 Ramp construction: Ramps used as an *exit* shall conform to the applicable requirements of 780 CMR 1014.9 as to materials of construction and enclosure.

1016.6.1 Surface: For all slopes exceeding one unit vertical in 20 units horizontal (1:20) and where the use is such as to involve danger of slipping, the ramp shall be surfaced with approved slip-resistant materials.

1016.6.2 Exterior ramps: Exterior ramps and landings shall be designed and constructed to prevent water from accumulating on the walking surface.

780 CMR 1017.0 MEANS OF EGRESS DOORWAYS

1017.1 General: The requirements of 780 CMR 1017.0 shall apply to all doorways serving as a component or element of a *means of egress*, except as provided for in 780 CMR 1014.8, 1014.12.2, 1015.5.1.1015.5.2 and 1015.6.1.

1017.1.1 Floor surface: The floor surface on both sides of a door shall be at the same elevation. The floor surface over which the door swings shall be at the same elevation as the floor level at the threshold and shall extend from the door in the closed position a distance equal to the door width.

Exception: This requirement shall not apply to:

1. Exterior doors, as provided for in 780 CMR 1005.6, which are not on an accessible route.
2. Variations in elevation due to differences in finish materials, but not more than ½ inch (13 mm).

Thresholds at doorways shall not exceed ¾ inch (19 mm) in height above the finished floor surface for exterior residential sliding doors or ½ inch (13 mm) for all other doors. Raised thresholds and floor level changes greater than ¼ inch (6 mm) at doorways shall be beveled with a slope not greater than one unit vertical in two units horizontal (1:2).

1017.2 Number of doorways: Each occupant of a room or space shall have access to at least two *exits* or *exit access* doors from the room or space where the occupant load of the space exceeds that listed in Table 1017.2, or where the travel distance from any point within the space to an *exit* or *exit access* door exceeds that listed in Table 1017.2. Where the occupant load of a room or space is between 501 and 1,000, a minimum of three *exits* or *exit access* doors shall be provided. Where the occupant load of a room or space exceeds 1,000, a minimum of four *exits* or *exit access* doors shall be provided.

Exceptions:

1. Boiler, incinerator and furnace rooms shall be provided with two egress doorways where the area exceeds 500 square feet (47 m^2) and individual fuel-fired equipment exceeds 400,000 Btuh (117 kW) input capacity. Door ways shall be separated by a horizontal distance equal to not less than one-half of the diagonal dimension of the room. Where two doorways are required by this exception, a fixed ladder access out of the room shall be permitted in lieu of one doorway.
2. In an occupancy in Use Group I-2, any room and any suite of rooms as permitted in 780 CMR 1011.1.1, Exception No.3, of more than 1,000 square feet (93 m^2), shall have at least two *exit access* doors remote from each other.

Table 1017.2
SPACES WITH ONE MEANS OF EGRESS

Use Group	Maximum occupant load	Maximum travel distance (feet)[b]
A, B, E, F, M	50	75
H-1[a], H-2, H-3	3	25
H-4	10	75
I, R	10	75
S	30	100

Note a. For requirements for areas and spaces in Use Group H-1, see 780 CMR 418.2.2.

Note b. 1 foot = 304.8 mm.

1017.2.1 Entrance and egress doorways: Where separate doors are provided for entrance and *means of egress*, the entrance door shall be clearly marked "Entrance Only" in letters not less than six inches (152 mm) in height and legible from both inside and outside.

1017.2.2 Location of doors: The required doorways opening from a room or space within a building and leading to an *exit access* shall be located as remote as practicable from each other and shall conform to 780 CMR 1006.4.1. The distance of *exit access* travel from any point in a room or space to a required *exit* door shall not exceed the limitations of 780 CMR 1006.5.

1017.2.3 Door arrangement: The space between doors in series shall not be less than seven feet (2134 mm) as measured when the doors are in the closed position.

Exception: Power-operated doors and occupancies in Use Groups I-1 and R-3.

1017.3 Size of doors: The minimum width of each door opening shall be sufficient for the occupant load thereof and shall provide a clear width of not less than 32 inches (813 mm). Where 780 CMR 1017.0 requires a minimum clear width of 32 inches (813 mm) and a door opening includes two door leaves without a mullion, one leaf shall provide a clear opening width of 32 inches (813 mm). The maximum width of a swinging door leaf shall be 48 inches nominal. *Means of egress* doors in an occupancy in Use Group I-2 used for the movement of beds shall be at least 44 inches (1118 mm) wide. The height of doors shall not be less than 80 inches (2032 mm). For A-2 occupancies where the occupant load is 50 or greater refer to 780 CMR 1006.2.2.1

Exceptions:

1. A *means of egress* door serving a storage area of not more than 800 square feet (74 m^2) and which is normally unoccupied shall have a maximum width of ten feet (3048 mm).
2. The minimum and maximum width shall not apply to doors that are not required for *means of egress* in occupancies in Use Groups R-2 and R-3.
3. Door openings to resident sleeping rooms in occupancies in Use Group I-3 shall have a clear width of not less than 28 inches (711 mm).
4. Door openings to storage closets less than ten square feet (0.93 m^2) in area shall not be limited by the minimum width.
5. Width of door leafs in revolving doors that comply with 780 CMR 1018.0 shall not be limited.
6. Door openings within a *dwelling unit* shall not be less than 78 inches (1981 mm) in height.
7. Exterior door openings in *dwelling units*, other than the required *exit* door, shall not be less than 76 inches (1930 mm) in height.
8. Interior egress doorways within a *dwelling unit* not required to be adaptable or accessible shall have a minimum clear width of 29¾-inches (755 mm).

1017.4 Door hardware: Door handles, pulls, latches, locks and other operating devices shall be at a maximum height of 48 inches (1219 mm) above the finished floor. The operating devices shall be capable of operation with one hand and shall not require tight grasping, tight pinching or twisting of the wrist to operate. All *means of egress* doors shall be of a side-swinging type. All doors shall swing in the direction of egress where serving an occupant

#322

THE COMMONWEALTH OF MASSACHUSETTS

William Francis Galvin

Secretary of the Commonwealth

Notice of Compliance

Regulation Filing *To be completed by filing agency*

CHAPTER NUMBER: 780 CMR 28

CHAPTER TITLE: Mechanical Systems

AGENCY: Department of Public Safety / Board of Building Regulations and Standards

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William Francis Galvin

WILLIAM FRANCIS GALVIN

SECRETARY OF THE COMMONWEALTH

DATE 8/26/05 CLERK

1015.7.3 Acceptance and testing: Before the mechanical equipment is approved, the system shall be tested in the code official's presence to confirm that the system is operating in compliance with these requirements.

780 CMR 1016.0 RAMPS

1016.1 Capacity: The capacity of a ramp used as a *means of egress* component shall be computed in accordance with 780 CMR 1009.0.

Note: For ramp design requirements related to building access issues, refer to 780 CMR 11.00

1016.2 Minimum dimensions: The minimum dimensions of *means of egress* ramps shall comply with 780 CMR 1016.2.1 through 1016.2.3.

1016.2.1 Width: The minimum width of a *means of egress* ramp shall not be less than that required for *corridors* by 780 CMR 1011.3.

1016.2.2 Headroom: The minimum headroom in all parts of the *means of egress* ramp shall not be less than 80 inches (2032 mm).

1016.2.3 Restrictions: *Means of egress* ramps shall not reduce in width in the direction of egress travel. Projections into the required ramp and landing width are prohibited except at and below handrail height where, at each handrail, the projections shall not exceed 3½ inches (89 mm) into the required width. Doors opening onto a landing shall not reduce the clear width to less than 42 inches (1067 mm).

1016.3 Maximum slope: The maximum slope of *means of egress* ramps in the direction of travel shall be one unit vertical in 12 units horizontal (1:12); except the maximum slope shall be: one unit vertical in eight units horizontal (1:8) if the rise is limited to three inches (76 mm); one unit vertical in ten units horizontal (1:10) if the rise is limited to six inches (152 mm). The maximum slope across the direction of travel shall be one unit vertical in 48 units horizontal (1:48).

Exception: Aisles in areas of Use Group A shall comply with 780 CMR 1012.0.

1016.4 Landings: Ramp slopes of one unit vertical in 12 units horizontal (1:12) or steeper shall have landings at the top, bottom, all points of turning, entrance, *exit* and at doors. Ramps shall not have a vertical rise greater than 30 inches (762 mm) between landings. The maximum slope of landings shall be one unit vertical in 48 units horizontal (1:48). The least dimension of a landing shall not be less than the required width of the ramp except that the landing dimension in the direction of travel is not required to exceed four feet (1219 mm) where the travel from one ramp to the next ramp is a straight run.

Exception: Aisles in areas of Use Group A shall comply with 780 CMR 1012.0.

1016.5 Guards and handrails: Guards shall be provided on both sides of the ramp and shall be constructed in accordance with 780 CMR 1021.0. Handrails conforming to 780 CMR 1022.0 shall be provided on both sides of every ramp having a slope greater than one unit vertical in 20 units horizontal (1:20). Handrails are not required on ramps where the vertical rise between landings is six inches (152 mm) or less.

Exception: Handrails in aisles in occupancies in Use Group A shall comply with 780 CMR 1012.0.

1016.5.1 Drop-offs: The sides of ramps and landings with a drop-off shall have a curb with a minimum four-inch (102 mm) height above the walking surface or shall be provided with a guardrail.

1016.6 Ramp construction: Ramps used as an *exit* shall conform to the applicable requirements of 780 CMR 1014.9 as to materials of construction and enclosure.

1016.6.1 Surface: For all slopes exceeding one unit vertical in 20 units horizontal (1:20) and where the use is such as to involve danger of slipping, the ramp shall be surfaced with approved slip-resistant materials.

1016.6.2 Exterior ramps: Exterior ramps and landings shall be designed and constructed to prevent water from accumulating on the walking surface.

780 CMR 1017.0 MEANS OF EGRESS DOORWAYS

1017.1 General: The requirements of 780 CMR 1017.0 shall apply to all doorways serving as a component or element of a *means of egress*, except as provided for in 780 CMR 1014.8, 1014.12.2, 1015.5.1.1015.5.2 and 1015.6.1.

1017.1.1 Floor surface: The floor surface on both sides of a door shall be at the same elevation. The floor surface over which the door swings shall be at the same elevation as the floor level at the threshold and shall extend from the door in the closed position a distance equal to the door width.

Exception: This requirement shall not apply to:

1. Exterior doors, as provided for in 780 CMR 1005.6, which are not on an accessible route.
2. Variations in elevation due to differences in finish materials, but not more than ½ inch (13 mm).

Thresholds at doorways shall not exceed ¾ inch (19 mm) in height above the finished floor surface for exterior residential sliding doors or ½ inch (13 mm) for all other doors. Raised thresholds and floor level changes greater than ¼ inch (6 mm) at doorways shall be beveled with a slope not greater than one unit vertical in two units horizontal (1:2).

1017.2 Number of doorways: Each occupant of a room or space shall have access to at least two *exits* or *exit access* doors from the room or space where the occupant load of the space exceeds that listed in Table 1017.2, or where the travel distance from any point within the space to an *exit* or *exit access* door exceeds that listed in Table 1017.2. Where the occupant load of a room or space is between 501 and 1,000, a minimum of three *exits* or *exit access* doors shall be provided. Where the occupant load of a room or space exceeds 1,000, a minimum of four *exits* or *exit access* doors shall be provided.

Exceptions:

1. Boiler, incinerator and furnace rooms shall be provided with two egress doorways where the area exceeds 500 square feet (47 m^2) and individual fuel-fired equipment exceeds 400,000 Btuh (117 kW) input capacity. Door ways shall be separated by a horizontal distance equal to not less than one-half of the diagonal dimension of the room. Where two doorways are required by this exception, a fixed ladder access out of the room shall be permitted in lieu of one doorway.
2. In an occupancy in Use Group I-2, any room and any suite of rooms as permitted in 780 CMR 1011.1.1, Exception No.3, of more than 1,000 square feet (93 m^2), shall have at least two *exit access* doors remote from each other.

Table 1017.2
SPACES WITH ONE MEANS OF EGRESS

Use Group	Maximum occupant load	Maximum travel distance (feet)[b]
A, B, E, F, M	50	75
H-1[a], H-2, H-3	3	25
H-4	10	75
I, R	10	75
S	30	100

Note a. For requirements for areas and spaces in Use Group H-1, see 780 CMR 418.2.2.

Note b. 1 foot = 304.8 mm.

1017.2.1 Entrance and egress doorways: Where separate doors are provided for entrance and *means of egress*, the entrance door shall be clearly marked "Entrance Only" in letters not less than six inches (152 mm) in height and legible from both inside and outside.

1017.2.2 Location of doors: The required doorways opening from a room or space within a building and leading to an *exit access* shall be located as remote as practicable from each other and shall conform to 780 CMR 1006.4.1. The distance of *exit access* travel from any point in a room or space to a required *exit* door shall not exceed the limitations of 780 CMR 1006.5.

1017.2.3 Door arrangement: The space between doors in series shall not be less than seven feet (2134 mm) as measured when the doors are in the closed position.

Exception: Power-operated doors and occupancies in Use Groups I-1 and R-3.

1017.3 Size of doors: The minimum width of each door opening shall be sufficient for the occupant load thereof and shall provide a clear width of not less than 32 inches (813 mm). Where 780 CMR 1017.0 requires a minimum clear width of 32 inches (813 mm) and a door opening includes two door leaves without a mullion, one leaf shall provide a clear opening width of 32 inches (813 mm). The maximum width of a swinging door leaf shall be 48 inches nominal. *Means of egress* doors in an occupancy in Use Group I-2 used for the movement of beds shall be at least 44 inches (1118 mm) wide. The height of doors shall not be less than 80 inches (2032 mm).

Exceptions:

1. A *means of egress* door serving a storage area of not more than 800 square feet (74 m^2) and which is normally unoccupied shall have a maximum width of ten feet (3048 mm).
2. The minimum and maximum width shall not apply to doors that are not required for *means of egress* in occupancies in Use Groups R-2 and R-3.
3. Door openings to resident sleeping rooms in occupancies in Use Group I-3 shall have a clear width of not less than 28 inches (711 mm).
4. Door openings to storage closets less than ten square feet (0.93 m^2) in area shall not be limited by the minimum width.
5. Width of door leafs in revolving doors that comply with 780 CMR 1018.0 shall not be limited.
6. Door openings within a *dwelling unit* shall not be less than 78 inches (1981 mm) in height.
7. Exterior door openings in *dwelling units*, other than the required *exit* door, shall not be less than 76 inches (1930 mm) in height.
8. Interior egress doorways within a *dwelling unit* not required to be adaptable or accessible shall have a minimum clear width of 29¾-inches (755 mm).

1017.4 Door hardware: Door handles, pulls, latches, locks and other operating devices shall be at a maximum height of 48 inches (1219 mm) above the finished floor. The operating devices shall be capable of operation with one hand and shall not require tight grasping, tight pinching or twisting of the wrist to operate. All *means of egress* doors shall be of a side-swinging type. All doors shall swing in the direction of egress where serving an occupant load of 50 or more persons or where serving a high-hazard occupancy. The opening force for interior sideswinging doors without closers shall not exceed a five-pound (24 N) force. For all other side-swinging, sliding and folding doors, the door latch shall release when subjected to a 15-pound (73 N) force. The door shall be set in motion when subjected to a 30-pound (146 N) force. The door shall swing to a full-open position when subjected to a 15-pound (73 N) force. Forces shall be applied to the latch side.

Exceptions:

1. Doors to *private garages*, factory and storage areas with an occupant load of ten or less.
2. Horizontal sliding-type doors complying with 780 CMR 410.4.2 shall be permitted in a *means of egress* in occupancies in Use Group I-3.
3. Doors within or serving a single *dwelling unit* which is not required to be accessible or adaptable by 780 CMR 11, are not required to be provided with lever handled operating devices.
4. Revolving doors conforming to 780 CMR 1018.0.
5. Horizontal sliding doors complying with 780 CMR 1017.4.4 shall be permitted in a *means of egress* in areas of refuge as described in 780 CMR 1007.5 and areas, other than high-hazard occupancies, that serve an occupant load of less than 50.

1017.4.1 Locks and latches: All *means of egress* doors shall be readily openable from the side from which egress is to be made without the use of a key or special knowledge or effort. ***Refer to M.G.L. c. 143 § 3R for locking devices on the exterior doors of apartment houses.***

Exceptions

1. Key operation shall be permitted from a *dwelling unit* provided that the key cannot be removed from the lock when the door is locked from the side from which egress is to be made.
2. Locking devices conforming to 780 CMR 409.3.2 shall be permitted in occupancies in Use Group I-2.
3. Locks conforming to 780 CMR 410.4 shall be permitted in occupancies in Use Group I-3.
4. *Means of egress* doors from individual *dwelling units* and guestrooms of occupancies in Use Group R having an occupant load of ten or less shall be permitted to be equipped with a night latch, dead bolt or security chain, provided that such devices are openable from the inside without the use of a key or tool and are mounted at a height not to exceed 48 inches (1219 mm) above the finished floor.
5. Special locking arrangements conforming to 780 CMR 1017.4.1.2 or 780 CMR 1017.4.1.3.
6. In occupancies in Use Groups B, F, M and S, the main exterior *means of egress* door is permitted to be equipped with a key-operated locking device from the egress side where in compliance with the following three conditions:
    6.1. The locking device is of a type that is readily distinguishable as locked.
    6.2. A readily visible, durable sign is posted on the egress side on or adjacent to the door stating "This Door To Remain Unlocked When This Building Is Occupied." The sign shall be in letters not less than one inch (25 mm) high on a contrasting background.
    6.3. The main exterior door is a single door or a pair of doors which, when unlocked, the door or both leafs of a pair of doors swing free.
7. Locking arrangements conforming to 780 CMR 1017.4.5.
8. ***In occupancies in Use Group I-1 and I-2 locks shall be permitted under the following conditions:***
    a. Patient sleeping room doors may be provided with key locking devices that restrict access to the room from the corridor and that are openable only by staff from the corridor side, provided such device shall not restrict egress from the sleeping room.
    b. All other means of egress doors may be provided with key locking devices where the clinical needs of the patients require specialized security measures for their safety, or for the protection of the public, provided keys are carried 24 hours per day by staffing at all times, who have been trained in emergency evacuation procedures.

1017.4.1.1 Flush and surface bolts: Manually operated edge or surface-mounted flush bolts and surface bolts are prohibited. Where *means of egress* doors are used in pairs and approved automatic flush bolts are used, the door leafs having the automatic flush bolts shall not have a door knob or surface-mounted hardware. The unlatching of any leaf shall not require more than one operation.

1017.4.1.2 Special locking arrangements: In buildings that are equipped throughout with an *automatic sprinkler system* installed in accordance with 780 CMR 906.2.1 or with an automatic fire detection system, doors in a *means of egress* serving occupancies in Use Group B, E, F, I, M, S or R, shall be unlocked or shall be equipped with approved egress control devices which shall unlock in accordance with items 780 CMR 1017.4.1.2.1 through 7. A building occupant shall not be required to pass through more than one door equipped with a special locking device before entering an *exit*.

1. Actuation of the *automatic sprinkler system* or automatic fire detection system.

2. Loss of power to the egress control device.
3. Loss of power to the building.
4. Capability of being unlocked manually by a signal from an *emergency control station*.
5. The initiation of an irreversible and automatic process that will release the latch within 15 seconds when a force of not more than 15 pounds (73 N) is applied for one second to the release device and not relock until the door has been opened and returned to the closed position for not less than 30 seconds. Any reopening of the door shall restart the 30-second relocking cycle. Any attempt to *exit* which exceeds one second shall render the door openable. The time delay and the minimum relocking cycle time shall not be field adjustable.

Exceptions:

1. An increase in the time delay to 30 seconds shall not be permitted except as approved by the code official.
2. An increase in the relocking cycle time to 45 seconds shall not be permitted except as approved by the code official.
3. ***In Use Group B buildings where one tenant occupies the entire floor and the building has a security station staffed 24 hours each day, the installation of a door release device described in 780 CMR 1017.4.1.2, item 5, may be omitted on egress doors in elevator lobbies provided that all other items in 780 CMR 1017.4.1.2 are met, and in addition, the following items are met:***
   a. ***The building is equipped throughout with both a supervised automatic fire sprinkler system and a supervised automatic fire alarm system.***
   b. ***The supervised automatic fire sprinkler system and the supervised fire alarm system shall interface with the access control system to unlock the doors automatically upon activation of either system.***
   c. ***The elevator lobby shall be equipped with a telephone connected directly to the staffed security station and a sign having block letters one inch in height shall be provided directly above the telephone and shall state: "In case of emergency, pick up telephone. You will be connected directly to security personnel".***

6. Initiation of the irreversible process shall activate an audible alarm in the vicinity of the door.
7. A sign having block letters of one inch (25 mm) in height shall be provided on the door above and within 12 inches (305 mm) of the release device stating "Push until alarm sounds. Door can be opened in 15 seconds."

1017.4.1.3 Security locking arrangements in penal facilities: In occupancies in Use Groups A-3, A-4, B, E, F, 1, M and S within penal facilities, doors in *means of egress* serving rooms or spaces occupied by persons whose movements must be controlled for security reasons shall be permitted to be locked if equipped with egress control devices which shall unlock manually and by at least one of the following means.

1. Actuation of an *automatic fire suppression* system required by 780 CMR 904.1.
2. Actuation of a key-operated manual alarm station required by 780 CMR 917.4.
3. A signal from a central control station.

1017.4.2 Panic hardware: All doors equipped with latching devices in occupancies in Use Groups A and E or portions of buildings occupied for assembly or educational purposes and serving rooms or spaces with an occupant load greater than 100, shall be equipped with approved panic hardware. Acceptable panic hardware shall be a door latching assembly incorporating a device which causes the door latch to release and the leaf to open when a force of 15 pounds (73 N) is applied in the direction of egress to a bar or panel, the activating portion of which extends not less than one-half of the width of the door leaf, and is applied at a height greater than 30 inches (762 mm) but less than 44 inches (1118 mm) above the floor. The force shall be applied at the lock side of the door or 30 inches (762 mm) from the hinged side, whichever is farther from the hinge. Where *fire door* assemblies are required to have panic hardware, approved fire *exit* hardware shall be used.

1017.4.3 Power-operated doors: Where *means of egress* doors are operated by power, such as doors with a photoelectric-actuated mechanism to open the door upon the approach of a person, or doors with power-assisted manual operation, the design shall be such that in the event of power failure, the door is capable of being opened manually to permit *means of egress* travel or closed where necessary to safeguard *means of egress*. The forces required to open these doors manually shall not exceed those specified in 780 CMR 1017.4 except that the force to set the door in motion shall not exceed 50 pounds (244 N). The door shall be capable of swinging from any position to the full width of the opening in which such door is installed when a force is applied to the door on the side from which egress is made.

Exceptions:
1. Occupancies in Use Group I-3.
2. Horizontal sliding doors complying with 780 CMR 1017.4.4.

1017.4.4 Horizontal sliding doors: In other than occupancies in Use Group H, horizontal sliding doors that are considered a component of a *means of egress* shall comply with all of the following criteria:
1. The door serves an occupant load of less than 50;
2. The door shall be power operated and be capable of being operated manually in the event of power failure;
3. The door shall be openable from both sides without special knowledge or effort;
4. The force required to operate the door shall not exceed 30 pounds (146 N) to set the door in motion and 15 pounds (73 N) to close the door or to open such door to the minimum required width;
5. The door shall be openable with a force not to exceed one ounds (73 N) when a force of 250 pounds (12220 N) is applied perpendicular to the door adjacent to the operating device;
6. The door assembly shall comply with the applicable fire protection rating and, where rated, shall be self-closing or automatic-closing by smoke detection, shall be installed in accordance with NFiPA 80 listed in ***Appendix A***, and shall comply with 780 CMR 716.0;
7. The door assembly shall have a standby power supply;
8. The door shall open to the minimum required width within ten seconds after activation of the operating device; and
9. The door assembly power supply shall be electrically supervised at a constantly attended location.

1017.4.5 Access-controlled egress doors: The entrance doors in a *means of egress* in buildings ith an occupancy in Use Group A, B, E, M, R-1 or R-2 and entrance doors to tenant spaces in occupancies in Use Groups A, B, E, M, R-1 and R-2 are permitted to be equipped with an approved entrance and egress access control system which shall be installed in accordance with items 780 CMR 1017.4.5. 1. through 6.
1. A sensor shall be provided on the egress side arranged to detect an occupant approaching the doors. The doors shall be arranged to unlock by a signal from or loss of power to the sensor.
2. Loss of power to that part of the access control system which locks the doors shall automatically unlock the doors.
3. The doors shall be arranged to unlock from a manual unlocking device located 40 inches (1016 mm) to 48 inches (1219 mm) vertically above the floor and within five feet (1524 mm) of the secured doors. Ready access shall be provided to the manual unlocking device and the device shall be clearly identified by a sign. When operated, the manual unlocking device shall result in direct interruption of power to the lock - independent of the access control system electronics - and the doors shall remain unlocked for a minimum of 30 seconds.
4. Activation of the building fire protective signaling system, if provided, shall automatically unlock the doors, and the doors shall remain unlocked until the fire protective signaling system has been reset.
5. Activation of the building *automatic sprinkler* or fire detection *system*, if provided, shall automatically unlock the doors. The doors shall remain unlocked until the fire protective signaling system has been reset.
6. Entrance doors in buildings with an occupancy in Use Group A, B, E or M shall not be secured from the egress side during periods that the building is open to the general public.

1017.5 Security grilles: Horizontal sliding or vertical security grilles which are part of a required *means of egress* shall be openable from the inside without the use of a key or special knowledge or effort during periods that the space is occupied. The grilles shall remain secured in the full-open position during the period of occupancy by the general public. Grilles shall not be brought to the closed position when there are more than ten persons occupying spaces served by a single *exit* or 50 persons occupying spaces served by more than one *exit*. Where two or more exits are required, not more than one-half of the *exits* shall be equipped with horizontal sliding or vertical security grilles.

1017.6 Level of exit discharge doors: Where glazed, doors at the *level of exit discharge* shall be glazed with approved safety glazing. Approved doors having one or more unframed edges shall be constructed of safety glazing not less than ½ inch thick. (Also see 780 CMR 2405)

780 CMR 1018.0 REVOLVING DOORS

1018.1 General: All revolving doors shall comply with 780 CMR 1018.2 through 1018.5. In other than occupancies in Use Group H, revolving doors that are considered a component of the *means of egress* shall comply with 780 CMR 1018.2 through 1018.6.

1018.2 Collapse: Each revolving door shall be capable of collapsing into a book-fold position with parallel egress paths having an aggregate width of not less than 36 inches (914 mm). The revolving door shall collapse when a force of not more than 180 pounds (880 N) is applied within 3 inches (76 mm) of the outer edge of a wing.

is reduced to not more than 130 pounds (635 N) when:

1. There is a power failure or power is removed to the device holding the wings in position.
2. There is an actuation of the *automatic sprinkler system* where such system is provided.
3. There is an actuation of an automatic fire detection system installed in accordance with 780 CMR 918.0 for all *areas* within the building which are within 75 feet (22860 mm) of the revolving doors. The collapse of the door(s) shall not be delayed by the *alarm verification* required by 780 CMR 918.7.
4. There is an actuation of a manual control switch which reduces the holding force to not more than the 130-pound (635 N) force level. Such switch shall be in an approved location and shall be clearly identified.

1018.3 Dispersal area: A revolving door shall not be located within ten feet (3048 mm) of the foot or top of *stairways* or *escalators*. A dispersal area shall be provided between the *stairways* or *escalators* and the revolving doors.

1018.4 Speed control: The revolutions per minute for a revolving door shall not exceed the speeds indicated in Table 1018.4.

Table 1018.4
REVOLVING DOOR SPEED

Inside diameter[a]	Power-driven type speed control (rpm)	Manual-type speed control (rpm)
6'6"	11	12
7'0"	10	11
7'6"	9	11
8'0"	9	10
8'6"	8	9
9'0"	8	9
9'6"	7	8
10'0"	7	8

Note a. 1 foot = 304.8 mm; 1 inch = 25.4 mm.

1018.5 Adjacent area: Each revolving door shall have a conforming side-hinged swinging door in the same wall as, and within ten feet (3048 mm) of, the revolving door.

Exception: The adjacent swinging door is not required for street floor elevator lobbies if a *stairway, escalator* or door from other parts of the building does not discharge through the lobby and the lobby does not have any occupancy other than as a means of travel between the elevators and street.

1018.6 Means of egress: A revolving door to be considered as a component of a *means of egress* shall comply with 780 CMR 1018.2 through 1018.5 and the following conditions:

1. Revolving doors shall not be given credit for more than 50% of the required *exit* capacity of the building.
2. Each revolving door shall not be credited with more than a 50-person capacity.
3. Each revolving door shall be capable of being collapsed when a force of not more than 130 pounds (635 N) is applied within three inches (76 mm) of the outer edge of a wing.

780 CMR 1019.0 HORIZONTAL EXITS

1019.1 General: *Horizontal exits* shall be accepted as an approved exit element of a required *means of egress*. The connection between an area of a building which the *horizontal exit* serves and the area of refuge as herein required shall be accomplished by protected openings in a fireresistance rated wall, or by an open-air balcony or bridge.

1019.2 Separation: The separation between buildings or areas of refuge connected by a *horizontal exit* shall be provided by at least a two-hour fireresistance rated *fire wall* or *fire separation assembly* with approved opening protectives complying with 780 CMR 7 and Table 602.

1019.2.1 Doors: All doors shall swing in the direction of egress travel. Where the *horizontal exit* serves as an *exit* from both sides of the wall, there shall be adjacent openings with swinging *fire doors* opening in opposite directions.

Exception: Horizontal sliding doors complying with 780 CMR 1017.4.4 where serving an occupant load of less than 50.

1019.3 Area of refuge: The discharge area of a *horizontal exit* shall be either public areas or spaces occupied by the same tenant, and each such area of refuge shall be adequate to hold the total occupant load of both connected areas. The capacity of areas of refuge shall be computed on a minimum *net floor area* allowance for each occupant to be accommodated therein, not including areas of *stairways*, elevators and other *shafts* or *courts*, as follows:

1. 30 square feet (2.8 m^2) per patient for hospitals and nursing homes.
2. Six square feet (0.56 m^2) per occupant on stories not housing patients confined to a bed or litter in an occupancy in Use Group I-2.
3. Six square feet (0.56 m^2) per occupant in an occupancy in Use Group I-3.
4. Three square feet (0.28 m^2) in all other cases.

1019.4 Egress from area of refuge: The path of egress travel from the *horizontal exit* through the area of refuge to another *exit* shall be continuously available. In other than occupancies in Use Group I-3, there shall be at least one *exit* on each side of the *horizontal exit* which is not a *horizontal exit*. Any area of refuge not having access to an *exit*, other than a *horizontal exit*, shall be considered as part of an adjoining area of refuge with such *exit*. In the area(s) served by the *horizontal exit*, the length of *exit access* travel distance to the *horizontal exit* or another *exit* shall not exceed the requirements of 780 CMR 1006.5. Occupancies in Use Group I-3 shall conform to 780 CMR 410.3.3.

780 CMR 1020.0 LEVEL OF EXIT DISCHARGE PASSAGEWAYS USED AS AN EXIT ELEMENT

1020.1 Passageways: Every required interior and exterior exit element which does not adjoin a *public way* shall be directly connected to the *public way* or to an open *court* leading to the *public way* by an enclosed passageway at the *level of exit discharge*, constructed in accordance with the requirements for the enclosure of the *exit* it serves, or through lobbies or vestibules as provided for in 780 CMR 1020.0. *Building areas* below the *level of exit discharge* shall be separated from the passageway in accordance with the requirements for the enclosure of *exits*.

1020.2 Vestibule: Where an *exit* discharges into an interior vestibule, the vestibule shall be used for ingress and *means of egress* only, and the vestibule shall comply with 780 CMR 1020.2.1 and 1020.2.2.

1020.2.1 Depth and width: The vestibule depth from the exterior of the building shall not be greater than ten feet (3048 mm) and the width shall not be greater than 20 feet (6096 mm).

1020.2.2 Separation: The vestibule shall be separated from the remainder of the *level of exit discharge* by self-closing doors and the equivalent of ¼-inch-thick wired glass in steel frames.

1020.3 Lobby: Where an *exit discharges* into an interior *lobby* located at the *level of exit discharge*, the story containing the lobby shall be equipped throughout with an *automatic sprinkler system* installed in accordance with 780 CMR 906.2.1 or 906.2.2. Opening protectives shall be required in accordance with Table 716.1 at the point in which an enclosed *exit stairway* discharges into a lobby.

Exception: An *automatic sprinkler system* is not required in areas that are separated from the *lobby* by *fire separation assemblies* (see 780 CMR 709.0) having a fireresistance rating of not less than that required for *exit* enclosures.

1020.4 Width and height: The clear width of the passageway shall not be less than the width required for the capacity of the *exit stairways* leading thereto and all required *exit* doorways opening into the passageway. Such passageway shall have a minimum width of 44 inches (1118 mm) and a minimum clear ceiling height of eight feet (23438 mm).

1020.5 Maximum stairway limitations: Not more than 50% of the required *stairways* shall discharge through the same passageway. Multiple *lobbies* constructed in accordance with 780 CMR 1020.3 located adjacent to one another shall be separated from each other in accordance with the requirements for enclosure of *exits*.

780 CMR 1021.0 GUARDS

1021.1 General: Where required by the provisions of 780 CMR 406.5, 408.3.2, 1005.5, 1014.7, 1016.5 and 1825.5, guards shall be designed and constructed in accordance with the requirements of 780 CMR 1021.0 and 780 CMR 1615.5. A guardrail system is a system of building components located near the open sides of elevated walking surfaces for the purpose of minimizing the possibility of an accidental fall from the walking surface to the lower level.

1021.2 Height: The guards shall be at least 42 inches (1067 mm) in height measured vertically above the leading edge of the tread or adjacent walking surface.

Exceptions:

1. In other than occupancies in Use Group E, guards shall not be less than 34 inches (864 mm) in height above the leading edge of the tread along stairs which are not more than 20 feet (6096 mm) in height or which reverse direction at an intermediate landing with 12 inches (305 mm) or less measured horizontally between successive flights.

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2. Guards along open-sided floor areas, *mezzanines* and landings in occupancies in Use Group R-3 shall not be less than 36 inches (914 mm) in height.

1021.3 Opening limitations: In occupancies in Use Groups A, B, E, H-4, I-1, I-2, M and R, and in *public garages* and open parking structures, open guards shall have balusters or be of solid material such that a sphere with a diameter of four inches (102 mm) cannot pass through any opening. Guards shall not have an ornamental pattern that would provide a ladder effect.

Exception: The triangular openings formed by the riser, tread and bottom rail at the open side of a *stairway* shall be of a maximum size such that a sphere six inches (152 mm) in diameter cannot pass through the opening.

In occupancies in Use Groups I-3, F, H-1, H-2, H-3 and S, other than *public garages* and open parking structures, balusters, horizontal intermediate rails or other construction shall not permit a sphere with a diameter of 21 inches (533 mm) to pass through any opening.

1021.4 Railings: Metal or other approved noncombustible railings shall be provided on balconies and galleries as prescribed in 780 CMR 1021.4.1 through 1021.4.3.

1021.4.1 At fascia: Railings shall be provided: at the fascia of boxes, balconies and galleries and shall not be less than 26 inches (660 mm) in height; at the end of aisles extending to the fascia for the full width of the aisle and shall not be less than 36 inches (914 mm) in height; and at the foot of steps for the full width of the steps and shall not be less than 42 inches (1067 mm) in height.

1021.4.2 At cross aisles: Railings shall be provided along cross aisles, and shall not be less than 26 inches (660 mm) in height except that railings are not required where the backs of the seats along the front of the aisles project 24 inches (610 mm) or more above the floor of the aisle.

1021.4.3 Successive tiers: Where seatings are arranged in successive tiers, and where the height of rise between platforms exceeds 18 inches (457 mm), railings not less than 26 inches (660 mm) in height shall be provided along the entire row of seats at the edge of the platform.

780 CMR 1022.0 HANDRAILS

1022.1 General: Where required by the provisions of 780 CMR 1012.5, 1013.0, 1014.6.6.1, 1014.7 and 1016.5, handrails shall be designed and constructed in accordance with 780 CMR 1022.0 and 780 CMR 1615.5. A handrail is a horizontal or sloping rail grasped by hand for guidance or support, and for arresting falls on the adjacent walking surface.

1022.2 Handrail details: Handrail-gripping surfaces shall be continuous, without interruption by newel posts, other structure elements or obstructions. A handrail and any wall or other surface adjacent to the handrail shall be free of any sharp or abrasive elements. The clear space between the handrail and the adjacent wall or surface shall not be less than 1½ inches (38 mm). Edges shall have a minimum radius of ⅛ inch (3 mm).

1022.2.1 Projection: Handrails shall not project more than 3½ inches (89 mm) into the required passageway, aisle, *corridor*, stair or ramp width.

1022.2.2 Height: Handrails shall not be less than 34 inches (864 mm) nor more than 38 inches (965 mm), measured vertically, above the leading edge of the treads or above the finished floor of the landing or walking surfaces.

Exceptions:

1. Handrails that form part of a guard shall have a height not less than 34 inches (864 mm) and not more than 42 inches (1067 mm).
2. Handrails within individual *dwelling units* shall not be less than 30 inches (762 mm) nor more than 38 inches (965 mm), measured vertically, above the leading edge of the treads or above the finished floor.

1022.2.3 Handrails in guards: Handrails that form part of a guard shall comply with 780 CMR 1021.3.

1022.2.4 Handrail ends: At locations where handrails are not continuous between *stairway* flights, including the top and bottom of a *stairway*, the handrails shall extend horizontally at least 12 inches (305 mm) beyond the top riser and continue to slope for the depth of one tread beyond the bottom riser. The handrail ends shall be returned to a wall or post.

Where handrails are not continuous between ramp segments, including the top and bottom of a ramp, the handrails shall extend at least 12 inches (305 mm) beyond the top and bottom of the ramp segment and shall be parallel with the floor or ground surface. The handrail ends shall be returned to a wall or post.

Exception: Within a *dwelling unit*, the horizontal extension beyond the top riser of the *stairway* flight or top of the ramp segment, and the extension beyond the bottom riser of the *stairway* flight or bottom of the ramp segment, is not required.

1022.2.5 Handrail grip size: All *stairway* handrails shall have a circular cross section with an outside diameter of at least 1¼-inches (32 mm) and not greater than two inches (51 mm).

Exceptions:

1. Any other shape with a perimeter dimension of at least four inches (100 mm), but not greater than 6¼ inches (158 mm) with the largest cross-sectional dimension not exceeding 2¼ inches (57 mm).
2. Approved rails of equivalent graspability.

1022.2.6 Handrails of alternating tread stairways: Stair handrails of *alternating tread stairways* shall be of such a configuration as to provide an adequate hand-hold for a person grasping the handrail to avoid falling. A minimum distance of six inches (152 mm) shall be provided between the stair handrail and any other object. A minimum distance of 12 inches (305 mm) shall be provided between the stair handrails of adjacent *alternating tread stairways*. Handrails on *alternating tread stairways* shall be spaced a minimum width of 17 inches (432 mm), not to exceed 24 inches (610 mm), between the handrails.

780 CMR 1023.0 EXIT SIGNS AND LIGHTS

1023.1 Location: In all buildings, rooms or spaces required to have more than one *exit* or *exit access*, all required *means of egress* shall be indicated with approved signs reading "Exit," visible from the *exit access* and, where necessary, supplemented by directional signs in the *exit access corridors* indicating the direction and way of egress. All "Exit" signs shall be located at *exit* doors or *exit access* areas, so as to be readily visible. Sign placement shall be such that any point in the *exit access* shall not be more than 100 feet (30480 mm) from the nearest visible sign.

Exceptions:

1. "Exit" signs are not required in sleeping room areas in occupancies in Use Group I-3.
2. Main exterior *exit* doors which are obviously and clearly identifiable as *exits* are not required to have "Exit" signs where approved.

1023.2 Size and color: "Exit" signs shall have red or green letters at least six inches (152 mm) high and the minimum width of each stroke shall be ¾ inch (19 mm) on a white background or in other approved distinguishable colors. The word "Exit," except the letter I, shall have letters having a width of not less than two inches (51 mm) and the minimum spacing between letters shall not be less than ⅜ inch (10 mm). Signs larger than the minimum size herein required shall have letter widths and spacing in the same proportions to the height as indicated in 780 CMR 1023.0. If an arrow is provided as part of an "Exit" sign, the construction shall be such that the arrow direction cannot be readily changed. The word "Exit" shall be clearly discernible when the sign illumination means is not energized.

Exception: All exit signs tested and listed to UL-924 as listed in Appendix A and satisfying the power source requirements of 780 CMR 1023.4 shall be permitted.

1023.3 Illumination: Each sign shall be illuminated by a source providing not less than five footcandles (54 lux) at the illuminated surface and shall have a contrast ratio of not less than 0.5.

Exception: Approved self-luminous signs which provide evenly illuminated letters shall have a minimum luminance of 0.06 foot lamberts (0.21 cd/m^2).

1023.4 Power source: All "Exit" signs shall be illuminated at all times that the building is occupied. To assure continued illumination for a duration of not less than 1½ hours in case of primary power loss, the "Exit" signs shall be connected to an emergency electrical system that complies with ***527 CMR 12.00, the Massachusetts Electrical Code, referenced in 780 CMR 27, and listed in Appendix A.***

Exceptions:

1. Approved self-luminous signs which provide continuous illumination independent of external power sources are not required to comply with 780 CMR 2706.0.
2. ***All exit signs tested and listed to UL-924 as listed in Appendix A and satisfying the power source requirements of 780 CMR 1023.4 shall be permitted.***

780 CMR 1024.0 MEANS OF EGRESS LIGHTING

1024.1 Artificial lighting: All *means of egress* in other than occupancies in Use Group R-3 shall be equipped with artificial lighting facilities to provide the intensity of illumination herein prescribed continuously during the time that conditions of occupancy of the building require that the *exits* be available. Lighting shall also be provided to illuminate the *exit discharge*. *Means of egress* lighting in occupancies in Use Group R-2, other than lighting within a *dwelling unit*, shall be wired on a circuit independent of circuits within any *dwelling unit*. The disconnecting means and overcurrent protection device shall not be located within a *dwelling unit* or such that access to such devices must be obtained by going through a *dwelling unit*.

1024.2 Intensity of illumination: The intensity of floor lighting shall not be less than one footcandle (11 lux) except as provided for in 780 CMR 1024.3.

1024.3 Use Groups A and E: In occupancies in Use Groups A and E for the exhibition of motion pictures or other projections by means of directed light, the minimum required illumination of aisles during such period of projection shall be 0.2 footcandle (2 lux).

1024.3.1 Control: The lighting of *exits*, aisles and auditoriums shall be controlled from a location that does not provide access to unauthorized persons. Supplementary control shall be provided as specified in 780 CMR 411.4 in the motion picture projection room.

1024.4 Power source: *Means of egress* lighting in all buildings, rooms or spaces required to have more than one *exit* or *exit access* shall be connected to an emergency electrical system that complies with ***527 CMR 12.00, the Massachusetts Electrical Code, referenced in 780 CMR 27, and listed in Appendix A*** to assure continued illumination for a duration of not less than 1½ hours in case of emergency or primary power loss.

780 CMR 1025.0 FIRE ESCAPES

1025.1 Where permitted: Fire escapes shall be permitted only as provided for in 780 CMR 1025.1.1 through 1025.1.4.

1025.1.1 New buildings: Fire escapes shall not constitute any part of the required *means of egress* in new buildings.

1025.1.2 Existing fire escapes: Existing fire escapes shall be continued to be accepted as a component in the *means of egress* in existing buildings only.

1025.1.3 New fire escapes: New fire escapes for existing buildings shall be permitted only where exterior stairs cannot be utilized due to *lot lines* limiting stair size or due to the sidewalks, alleys or roads at grade level. New fire escapes shall not incorporate ladders or access by windows.

1025.1.4 Limitations: Fire escapes shall comply with 780 CMR 1025.0 and shall not constitute more than 50% of the required number of *exits* nor more than 50% of the required *exit* capacity.

1025.2 Location: Where located on the front of the building and where projecting beyond the building line, the lowest landing shall not be less than seven feet (2134 mm) or more than 12 feet (3658 mm) above grade, and shall be equipped with a counterbalanced *stairway* to the street. In alleyways and thoroughfares less than 30 feet (9144 mm) wide, the clearance under the lowest landing shall not be less than 12 feet (3658 mm).

1025.3 Construction: The fire escape shall be designed to support a *live load* of 100 pounds per square foot (488.20 kg/m^2) and shall be constructed of steel or other approved noncombustible materials. Fire escapes constructed of wood not less than nominal two inches thick are permitted on buildings of Type 5 construction. Walkways and railings located over or supported by combustible roofs in buildings of Types 3 and 4 construction are permitted to be of wood not less than nominal two inches thick.

1025.3.1 Dimensions: Stairs shall be at least 22 inches (559 mm) wide with risers not more than, and treads not less than, eight inches (203 mm) and landings at the foot of stairs not less than 40 inches (1016 mm) wide by 36 inches (914 mm) long, located not more than eight inches (203 mm) below the door.

1025.3.2 Opening protectives: Doors and windows along the fire escape shall be protected with ¾-hour opening protectives.

780 CMR 1026.0 SLIDESCAPES

1026.1 Where permitted: Existing slidescapes and safety chutes shall be permitted in existing occupancies in Use Groups E, H and I where approved. Slidescapes and safety chutes shall be permitted in occupancies in Use Groups H-1 and H-2 where constructed in an approved manner.

1026.2 Location: The arrangement and location of slidescapes shall conform to 780 CMR 10 for *means of egress* and shall be designated by "Exit" signs and lights as provided for in 780 CMR 1023.0.

1026.3 Construction: All chutes shall be constructed of approved noncombustible materials with a pitch in the line of travel of not less than 24 nor more than 42° (0.42 rad to 0.73 rad), measured on the developed circumference of spiral chutes. Straight chutes shall not be less than 24 inches (610 mm) and spiral chutes shall not be less than 28 inches (711 mm) in clear width; nor more than 44 inches (1118 mm) wide in any case. Where erected on the interior of a building, the chutes shall be enclosed as required in 780 CMR 1014.11 for interior *stairways* with direct *means of egress* to a street or other *public way*.

1026.4 Capacity: Slidescapes shall have a rated egress capacity of 60 occupants per slide. Slidescapes, except as permitted for occupancies in Use Groups H-1 and H-2, shall not constitute more than 25% of the required *means of egress* capacity from any building or structure or any individual story.

780 CMR 1027.0 ACCESS TO ROOF

1027.1 By stairway or ladder: In buildings more than three stories in *height* except those with a roof slope greater than four units vertical in 12 units horizontal (4:12). access to the roof shall be provided by means of a *stairway*, an *alternating tread stair* in accordance with 780 CMR 1014.6.6 or a ladder and trap door. The ladder shall not be on the exterior of the building. Where the roof is used as a roof garden or for other habitable purposes, sufficient *stairways* shall extend to the roof to provide the necessity *exit* facilities from the roof as required for such occupancy. Roof trap doors shall be constructed to comply with 780 CMR 1510.2.

1027.1.1 Optional stairway or ladder: In buildings not required to have a *stairway*, *alternating tread stair* or ladder to the roof, such devices, if provided, shall conform to the provisions of 780 CMR 1027.0. Ladders placed on the exterior of the building shall be of metal and, if exceeding 20 feet (6096 mm) in height, shall have a protective cage or other safety device. The siderails of exterior ladders shall be carried over the coping or parapet to serve as handrails. Other design details of such exterior ladders are subject to approval.

1027.2 Roof enclosures: *stairways* extending through roofs shall be enclosed in roof structures of fireresistance rated construction which conform to the requirements of 780 CMR 1510.0.

780 CMR 1028.0 MAINTENANCE OF EXITS

1028.1 Obstructions: It shall be unlawful to obstruct, or reduce in any manner, the clear width of any doorway, hallway, passageway or other *means of egress* required by the provisions of 780 CMR.

1028.2 Maintenance: All exterior *stairways* and fire escapes shall be kept free of snow and ice. Exterior *stairways* and fire escapes constructed of materials requiring the application of weather protecting products, shall have these products applied in an approved manner and shall be applied as often as necessary to maintain the *stairways* and fire escapes in safe condition ***where corrodible structural parts of such stairways and fire escapes tie directly into the building structural system, all joints shall be sealed, as necessary, to prevent water from damaging or corroding structural elements.***

1028.3 Testing and Certification: All exterior bridges, steel or wooden stairways, fire escapes and egress balconies shall be examined and/or tested, and certified for structural adequacy and safety every five years, by a Massachusetts registered professional engineer, or others qualified and acceptable to the building official; said engineer or others shall then submit an affidavit to the building official.

NON-TEXT PAGE

CHAPTER 11

ACCESSIBILITY

(780 CMR 11 is Entirely Unique to Massachusetts)

780 CMR 1101.0 *M.G.L. c. 22, § 13A provides that all public buildings shall be designed to be accessible to, functional for and safe for the use by physically handicapped persons, in conformance with the Massachusetts Architectural Access Board's Rules and Regulations (521 CMR 1.00) listed in Appendix A and promulgated by the Architectural Access Board, Executive Office of Public Safety.*

In accordance with M.G.L. c. 143, § 3 and 780 CMR 106.1, said regulations shall be enforced by the municipal building code enforcement official or state inspector, as applicable

NON-TEXT PAGE

CHAPTER 12

INTERIOR ENVIRONMENT

780 CMR 1201.0 GENERAL

1201.1 Scope: The provisions of 780 CMR 12 shall govern the means of light, *ventilation*, sound transmission control and rat-proofing required in all buildings.

1201.2 Buildings on same lot: Where more than one building is hereafter placed on a *lot*, or where a building is placed on the same lot with *existing buildings* and the several buildings are treated as a single structure for the purposes of 780 CMR 12, equivalent uncovered *lot* area or other adequate sources of light and *ventilation* shall be provided for all occupied buildings.

780 CMR 1202.0 DEFINITIONS

1202.1 General: The following words and terms shall, for the purposes of 780 CMR 12 and as used elsewhere in 780 CMR, have the meanings shown herein.

Attic: The space between the ceiling beams of the top story and the roof rafters.

Court: An open, uncovered and unoccupied space on the same *lot* as a building where such space is enclosed wholly or partly by buildings, walls or other enclosing devices (see 780 CMR 1212.0).

Inner: Any *court* enclosed wholly by buildings, *walls* or other enclosing devices.

Outer: A *court* extending to and opening upon a street, public alley or other approved open space that is not less than 15 feet (4572 mm) wide, or upon a required yard.

Court height: The vertical distance from the lowest level of the *court* to the mean height of the top of the enclosing *walls*.

Court width: As applied to an *inner court*, means the least horizontal dimension. As applied to an *outer court*, means the shortest horizontal dimension measured in a direction substantially parallel with the principal open end of such *court*.

Habitable space: Space in a structure for living, sleeping, eating or cooking. Bathrooms, toilet compartments, closets, halls, storage or utility spaces and similar areas are not considered habitable spaces.

Occupiable space: A room or enclosed space designed for human occupancy in which individuals congregate for amusement, educational or similar purposes, or in which occupants are engaged at labor; and which is equipped with *means of egress* and light and *ventilation* facilities meeting the requirements of 780 CMR.

Vapor retarder: A material having a perm rating of 1.0 or less, such as foil, plastic sheeting, or insulation facing, installed to retard the passage of water vapor or moisture through the *exterior envelope*.

Ventilation: The natural or mechanical process of supplying conditioned or unconditioned air to, or removing such air from, any space.

Yard: An unoccupied open space other than a *court* (see 780 CMR 1212.0 and 1213.0).

780 CMR 1203.0 CONSTRUCTION DOCUMENTS

1203.1 General: *Construction documents* for all buildings and structures that are designed for human *occupancy*, other than buildings with occupancies in Use Groups I-1, R-2 and R-3, shall designate the number of occupants to be accommodated in the various rooms and spaces; where means of artificial lighting and *ventilation* are required, the application shall include sufficient details and description of the mechanical system to be installed as herein required or as specified in the mechanical code listed in *Appendix A*.

780 CMR 1204.0 ROOM DIMENSIONS

1204.1 Ceiling heights: *Habitable (spaces)* rooms other than kitchens shall have a ceiling height of not less than seven feet six inches (2286 mm). Hallways, *corridors*, bathrooms, toilet rooms, kitchens, laundry rooms and *habitable basements* that are only used as recreation rooms shall have a ceiling height of not less than seven feet (2134 mm) measured to the lowest projection from the ceiling.

Exception: In occupancies in Use Group R-3, the maximum projection below the required ceiling height of beams and girders spaced not less than four feet (1219 mm) on center shall be six inches (152 mm).

1204.1.1 Use Groups A, B, E and M: A clear height from the finished floor to the finished ceiling or lowest projection of not less than seven feet six inches (2286 mm) shall be provided in all exit access and occupiable rooms of structures of Use Groups A, B, E and M.

1204.1.2 Sloping ceilings: If any room in a building has a sloping ceiling, the prescribed ceiling height for the room is required in one-half the area thereof. Any portion of the room measuring less than five feet (1524 mm) from the finished floor to the finished ceiling shall not be included in any computation of the minimum area thereof.

1204.1.3 Furred ceilings: If any room has a furred ceiling, the prescribed ceiling height is required in two-thirds of the area thereof, but the height of the furred ceiling shall not be less than seven feet (2134 mm).

1204.2 Floor area: *Habitable* rooms, except kitchens, shall have an area of not less than 70 square feet (6.51 m^2).

1204.3 Width: A *habitable* room other than a kitchen shall not be less than seven feet (2134 mm) in any dimension.

780 CMR 1205.0 LIGHT AND VENTILATION REQUIRED

1205.1 Light required: Every room or space intended for human occupancy shall be provided with natural or artificial light.

1205.1.1 Bathroom and toilet room lighting: Every bathroom and toilet room shall be provided with artificial light. The illumination shall have an average intensity of three footcandles (32.29 lux) measured at a level of 30 inches (762 mm) above the floor.

1205.2 Ventilation required: Every room or space intended for human occupancy shall be provided with natural or mechanical *ventilation*.

1205.2.1: Every bathroom containing a bathtub and/or shower shall be equipped with a mechanical exhaust fan and associated ductwork with the fan exhausting, at such rates as specified in the BOCA National Mechanical Code/1993 as referenced in Appendix A. Passive ventilation methods such as openable windows shall not substitute for ventilation. Such bathroom exhaust shall vent directly to the outside and no exhaust vent shall terminate in attics or other interior portions of the building.

Note: See also 105 CMR 410.000

780 CMR 1206.0 NATURAL LIGHT

1206.1 General: ***Should natural lighting be chosen as a lighting option***, in the application of the provisions of 780 CMR 12, the standard of natural light for all *habitable* and *occupiable rooms*, unless otherwise specifically required by the provisions of 780 CMR 4 for special occupancies, shall be based on 250 footcandles (2691 lux) of illumination on the vertical plane adjacent to the exterior of the light-transmitting device in the enclosure *wall* and shall be adequate to provide an average illumination of six footcandles (64.58 lux) over the area of the room at a height of 30 inches (762 mm) above the floor level.

1206.2 Minimum glazing area: Every room or space intended for human occupancy shall have an exterior glazing area of not less than 8% of the floor area. Natural light shall be provided by glazing areas that open onto *courts* or yards which comply with the requirements of 780 CMR 1212.0, or by other approved means.

1206.2.1 Adjoining spaces: Where natural light for rooms or spaces without exterior glazing areas is provided through an adjoining room, the unobstructed opening to the adjoining room shall be at least 8% of the floor area of the interior room or space, but not less than 25 square feet (2.33 m^2). The exterior glazing area shall be based on the total floor area being served.

1206.3 Stairways: Interior *stairways* shall be provided with an exterior glazing area of not less than ten square feet (0.93 m^2) on every floor through which the *stairway* passes.

1206.4 Hallways: Natural light shall be capable of penetrating the full length of the hallway.

780 CMR 1207.0 ARTIFICIAL LIGHT

1207.1 General: ***Should artificial lighting be chosen as a lighting option***, artificial light shall be capable of providing the minimum illumination specified for natural light.

780 CMR 1208.0 NATURAL VENTILATION

1208.1 General: ***Should natural ventilation be chosen as a ventilation option***, natural *ventilation* of an occupied space shall be through windows, doors, louvers or other natural openings to the outdoor air.

Exception: All occupancies shall have mechanical *ventilation* in bathrooms and toilet rooms as specified in 780 CMR 1205.2.1.

1208.2 Ventilation area required: The minimum openable area to the outdoors shall be 4% of the floor area being *ventilated*.

1208.2.1 Adjoining spaces: Where rooms and spaces without openings to the outdoors are *ventilated* through an adjoining room, the unobstructed opening to the adjoining room shall be at least 8% of the floor area of the interior room or space, but not less than 25 square feet (2.33 m^2). The *ventilation* openings to the outdoors shall be based on the total floor area being *ventilated*.

1208.2.2 Openings below grade: Openings below grade shall be acceptable for natural *ventilation* provided that the outside horizontal clear space measured perpendicular to the opening is 1½ times the depth below the average adjoining grade.

1208.3 Contaminants exhausted: Contaminants in the breathing atmosphere shall be exhausted to the outdoor air in accordance with the mechanical code listed in *Appendix A*.

1208.4 Openings onto yards or courts: Natural *ventilation* shall be provided by openings onto yards or *courts* which comply with the requirements of 780 CMR 1212.0, or by other approved means.

780 CMR 1209.0 MECHANICAL VENTILATION

1209.1 General: ***Should mechanical ventilation be chosen as the ventilation option***, mechanical *ventilation* shall conform to the requirements of the mechanical code listed in *Appendix A*.

Note: Also see 780 CMR 1205.2.1

780 CMR 1210.0 VENTILATION OF SPECIAL SPACES

1210.1 Roof spaces: Enclosed *attics* and enclosed rafter spaces formed where ceilings are applied directly to the underside of roof rafters, shall have cross *ventilation* for each separate space by *ventilation* openings that are protected against the entrance of rain and snow. The openings shall be covered with corrosion-resistant mesh not less than ¼ inch (6 mm) nor more than ½ inch (13 mm) in any direction.

1210.1.1 Ventilating area: The minimum required net free ventilating area shall be 1/150 of the area of the space *ventilated*, except that the minimum required area shall be reduced to 1/300, provided that: a *vapor retarder* having a permeance not exceeding one perm is installed on the warm side of the ceiling; or at least 50%, and not more than 80%, of the required ventilating area is provided by ventilators located in the upper portion of the space to be *ventilated* at least three feet (914 mm) above eave or cornice vents, with the balance of the required *ventilation* provided by eave or cornice vents.

1210.2 Crawl spaces: Crawl space areas, other than those used as an underfloor plenum, shall be *ventilated* by an approved mechanical means or by openings in exterior *foundation walls*. Openings shall be located as close to corners as practicable and shall provide cross *ventilation* on at least two approximately opposite sides. The openings shall be covered with corrosion-resistant mesh not less than ¼ inch (6 mm) nor more than ½ inch (13 mm) in any direction.

1210.2.1 Opening size: Openings shall have a net area of not less than one square foot (0.093 m^2) for each 150 square feet (13.95 m^2) of foundation space. Where an approved *vapor retarder* is installed over the ground surface, the required net area of openings shall be reduced to 0.1 square foot (0.093 m^2) for each 150 square feet (13.95 m^2) and vents shall have manually operable louvers.

1210.3 Alternative mechanical ventilation: Enclosed *attic*, rafter and crawl spaces which are not *ventilated* as herein required shall be equipped with a mechanical *ventilation* system conforming to the requirements of the mechanical code listed in *Appendix A*.

780 CMR 1211.0 ACCESS TO CRAWL SPACES AND ATTICS

1211.1 Access to crawl spaces: Access shall be provided to crawl spaces by an opening not less than 18 inches (457 mm) by 24 inches (610 mm). ***Such access, if common to conditioned space, shall be weatherstripped and shall close tightly.***

1211.2 Access to attics: An opening not less than 22 inches by 30 inches (559 mm by 762 mm) with ready access thereto shall be provided to any *attic* area having a clear height of over 30 inches (762 mm). ***Such access, if adjoining conditioned space, shall be weatherstripped, and close tightly. All such access opening framing joints shall be caulked, gasketed, weatherstripped, foamed or otherwise sealed to limit infiltration/exfiltration***. Where doors or other openings are installed in attic *draftstopping*, such doors shall be self-closing and be of approved materials as specified in 780 CMR 1211.0, and the construction shall be tightly fitted around all pipes, ducts or other assemblies piercing the *draftstopping*.

780 CMR 1212.0 COURTS AND YARDS

1212.1 General: All *courts* and yards required to serve rooms for natural light or *ventilation* purposes shall comply with the requirements of 780 CMR 1212.0.

1212.2 Minimum width: Every such *court* or yard shall have a minimum width of three inches (76 mm) for each one foot (305 mm) of height or fraction thereof, but not less than five feet (1524 mm) for *outer courts* and twice these values for *inner courts*.

1212.2.1 Irregular court or yard width: In the case of irregular or gore-shaped *courts* or yards, the average width shall not be less than the required width of a *court* in accordance with 780 CMR 1212.2, but shall not be less than five feet (1524 mm) at any point.

1212.3 Area of court: The cross-sectional area of a required *court* shall not be less than 1½ times the square of its width; nor shall the length of any *court* be more than twice its width.

1212.4 Access to court: A door or other means of access shall be provided at the bottom of every *court* that is not otherwise provided with convenient access for purposes of cleaning.

1212.5 Air intakes: Every *court* which serves one or more *habitable* rooms and which does not open for its full height on one or more sides to a street or legal yard, shall be connected at or near the bottom with a street or yard by a horizontal intake or passage of fireresistance rated construction. Such intake or passage shall have a cross-sectional area of not less than 21 square feet (1.95 m^2) and shall remain fully open at both ends and unobstructed for its full size and length, except that grilles of noncombustible construction are permitted at the ends of the intake.

1212.5.1 Fireresistance rating: The *walls*, floors and ceilings of such intakes or passages shall have a fireresistance rating of not less than two hours in buildings of Type 1, 2, 3 or 4 construction and not less than a one-hour *fireresistance rating* in buildings of Type 5 construction.

1212.6 Court walls: Where, in the opinion of the code official, windows facing on *courts* do not receive adequate direct light by reason of peculiar arrangement or orientation, the code official shall require the *walls* to be constructed of light-colored masonry, or to be painted and maintained a light color to furnish additional reflected light, or shall require other approved means of providing additional light.

1212.7 Court drainage: The bottom of every *court* shall be properly graded and drained to a public sewer or other approved disposal system complying with the plumbing code listed in *Appendix A*; and shall be paved with concrete or other non-absorbent material where required by the code official.

780 CMR 1213.0 OBSTRUCTION OF COURTS AND YARDS

1213.1 Permissible projections: Every required *court* and yard shall remain unobstructed for its required area and full height, except for the projections permitted in 780 CMR 1213.2 through 1213.7.

1213.2 Maximum encroachment: A part of any building or structure shall not extend into side *courts*, *inner courts* or yards required for light and *ventilation* of *habitable* and *occupiable rooms* by the *zoning* law or other statutes controlling building construction. The encroachment shall not exceed 20% of the legal area of the yard or *court* which is required for light and *ventilation* purposes.

1213.3 Accessories: In Use Groups R and I, clothes poles, arbors, garden trellises and other such accessories shall not be prohibited in the open spaces at ground level.

1213.4 Roof eaves: Roof eaves shall not project more than three feet (914 mm) beyond the face of the *wall*.

1213.5 Steps and architectural features: Steps, window sills, belt courses and similar architectural features, as well as rain leaders and chimneys, shall not project more than two feet (610 mm) beyond the face of the *wall*.

1213.6 Exterior stairways and fire escapes: Outside *stairways*, smokeproof tower balconies, fire escapes or other required elements of a *means of egress* shall not project more than four feet (1219 mm) beyond the face of the *wall*.

1213.7 Motor vehicle parking: Where approved, required *court* and yard areas for automobile parking spaces or *private garages* not exceeding one story in *height* where accessory to and only for the occupants of a Use Group R occupancy are permitted, provided that required windows for light and *ventilation* are not obstructed thereby.

780 CMR 1214.0 SOUND TRANSMISSION CONTROL IN RESIDENTIAL BUILDINGS

1214.1 Scope: 780 CMR 1214.0 shall apply to all common interior *walls*, partitions and floor/ceiling assemblies between adjacent *dwelling units* or between *dwelling units* and adjacent public areas such as halls, *corridors*, stairs or service areas in all occupancies in Use Group R.

1214.2 Air-borne noise: *Walls*, partitions and floor/ceiling assemblies separating *dwelling units* from each other or from public or service areas shall have a sound transmission class (STC) of not less than 45 for air-borne noise when tested in accordance with ASTM E90 listed in *Appendix A*. This requirement shall not apply to *dwelling unit* entrance doors; however, such doors shall be tight fitting to the frame and sill.

1214.3 Structure-borne sound: Floor/ceiling assemblies between *dwelling units* or between a *dwelling unit* and a public or service area within the structure shall have an impact insulation class (IIC) rating of not less than 45 when tested in accordance with ASTM E492 listed in *Appendix A*.

780 CMR 1215.0 RATPROOFING

1215.1 Ratproofing: All buildings or structures and the *walls* enclosing *habitable* or *occupiable rooms* and spaces in which persons live, sleep or work, or in which feed, food or foodstuffs are stored, prepared, processed, served or sold, shall be constructed in accordance with the provisions of 780 CMR 1215.0.

1215.2 Grade protection: Buildings not provided with a continuous foundation shall be provided with protection against rodents at grade in accordance with either 780 CMR 1215.2.1 or 1215.2.2.

1215.2.1 Apron: Where an apron is provided, the apron shall not be less than eight inches (203 mm) above, nor less than 24 inches (610 mm) below grade. In all cases the apron shall not terminate below the lower edge of the siding material. The apron shall be constructed of an approved nondecayable, water-resistant and ratproofing material of required strength and shall be installed around the entire perimeter of the building. Where constructed of masonry or concrete materials, the apron shall not be less than four inches (102 mm) in thickness.

1215.2.2 Grade floors: Where continuous concrete grade floor slabs are provided, open spaces shall not be left between the slab and *walls*, and all openings in the slab shall be protected.

1215.3 Opening protection: Openings shall be protected in accordance with 780 CMR 1215.3.1 through 1215.3.3.

1215.3.1 Wall openings: Openings in the *wall* or apron required for *ventilation* or other purposes shall be guarded with corrosion-resistant ratproof shields of not less than nominal 0.034-inch perforated steel sheets, or No. 20 B&S Gage aluminum (0.032 inch) or nominal 0.064-inch expanded steel or wire mesh screens, with not more than ½-inch (13 mm) mesh openings.

1215.3.2 Slab openings: Access openings in grade floor slabs shall be protected with concrete, masonry, metal or other corrosion-resistant noncombustible cover of adequate strength to support the floor *loads*.

1215.3.3 Pipe and conduit openings: All openings for pipe, conduit, cable and similar purposes at or near grade shall have snugly fitted collars to eliminate all open spaces.

NON-TEXT PAGE

CHAPTER 13

ENERGY CONSERVATION

(This Chapter is entirely unique to Massachusetts)

NOTE: The provisions of Chapter 13 specified herein apply to projects for which permit applications are made after January 1, 2001.

Exception 1: Between January 1, 2001 and June 30, 2001, projects may utilize either the provisions of Chapter 13 as specified herein, or the provisions of Chapter 13 specified in 780 CMR Sixth Edition effective 2/28/97.

Exception 2: Tables 1305.3.3a through f (HVAC equipment performance requirements) do not take effect until October 29, 2001.

780 CMR 1301.0 ADMINISTRATION

1301.1 Scope: 780 CMR 13 sets forth requirements for the effective use of energy in structures other than *low rise residential buildings*, which shall be designed and constructed to comply with the requirements of 780 CMR APPENDIX J.

> **Exception**: For the purposes of energy conservation, Use Group R-1 buildings are to be treated as *commercial buildings*.

1301.2 Compliance: Buildings shall be deemed to be in compliance with 780 CMR 13 when built to the provisions of 780 CMR 1301 and 1303, and either:

1. 780 CMR 1303 through 1308; or
2. 780 CMR 1309.

> **Exception**: As an alternative to the provisions of 780 CMR 1304, buildings with total floor area not greater than 10,000 square feet may be designed and constructed using the envelope requirements of 780 CMR APPENDIX J.

1301.2.1 Heating, Pumping, Process Piping and Refrigeration Systems: Heating, pumping, process piping and refrigeration systems shall be installed by contractors and personnel appropriately licensed in the Commonwealth of Massachusetts (Installing Contractor). Engineered designs and specifications prepared by Registered Professional Engineers shall identify systems requiring compliance with appropriate sections of M.G.L. c. 146 and 528 CMR. Shop drawings and design layout prepared by licensed installing contractors shall note the name(s), license number(s) and license expiration date(s) of the contractor(s) installing the heating, pumping, process piping and refrigeration systems. (See Installing Contractor Definition 780 CMR 202.0).

1301.3 Other Regulations: 780 CMR 13 is not intended to abridge any safety or health provisions required under any other applicable codes or ordinances.

1301.4 Existing Buildings: Nothing in 780 CMR 13 shall require the removal, alteration, or abandonment, or prevent the continuance of the use and occupancy of, a lawfully existing building, unless provided otherwise specifically by 780 CMR 13.

1301.5 Additions to Existing Buildings: Additions to existing buildings or structures shall be made without making the entire building or structure comply. The new construction shall conform to the provisions of 780 CMR 13 as they relate to the addition only.

1301.6 Alterations to Existing Buildings: See 780 CMR 3407.

1301.7 Exempt Buildings: The following buildings are exempt from the further provisions of 780 CMR 13, with the exception of 780 CMR 1308.0 dealing with lighting requirements:

1. Buildings and structures or portions thereof whose peak design rate of energy usage is less than one watt per square foot or three and four tenths (3.4) Btu/h per square foot of floor area for all purposes;
2. Buildings and structures or portions thereof which are neither heated nor cooled;
3. *Greenhouses* that are free-standing, or attached to a building and separated by a wall having the same thermal value as an exterior wall, and provided with a separate temperature control system;
4. Buildings with less than 100 square feet of gross floor area.
5. Portions of aircraft hangars where aircraft are housed or stored and/or aircraft servicing, repairs or alterations may occur. Such hangars are also exempt from the lighting requirements of 780 CMR 1308.

1301.8 Plans and Specifications

1301.8.1 General: Plans, specifications and necessary computations shall be submitted to indicate conformance with 780 CMR 1301.8 and other applicable sections of 780 CMR. Submittals shall include Mandatory Checklist approved by the Board of Building Regulations and Standards.

1301.8.2 Construction Details: Compliance documents shall show all pertinent data and features of the *building*, *equipment*, and *systems* in sufficient detail to permit a determination of the compliance by the *building* official and to indicate compliance with the requirements of this standard. Supplemental information necessary to verify compliance with this standard, such as calculations, worksheets, compliance forms, vendor literature, or other data, shall be made available when required by the *building official*

1301.8.3 Calculation Procedures: Calculation procedures shall be in accordance with the ASHRAE Handbook, 1997 Fundamentals Volume or as otherwise specified in 780 CMR 13.

1301.8.4 Approval and Acceptance of Heating, Ventilating, and Air Conditioning (HVAC); Lighting; and Electric Distribution Systems:

1301.8.4.1 Construction Documents: The construction documents shall contain sufficient information to completely describe the heating, ventilation, and air conditioning (HVAC); lighting; and electric power distribution systems, including operational features and controls. The information required for each system shall include a summary of:

1. A description of the design intent providing a detailed explanation of the ideas, concepts and criteria that are defined by the owner to be important.
2. A description of the basis of design of the systems including all information necessary to prepare a design to accomplish the design intent.
3. A description of the sequence of operation of the systems and their interaction with other systems, including fire prevention and fire protection systems.
4. A description of the systems including the capacities of the equipment or systems.
5. A description of the testing requirements and the criteria for passing to be used for final systems acceptance.
6. A requirement for submittal of operation manuals and maintenance manuals as a condition of final acceptance, and a description of their format and content. The operation manual shall provide all relevant information needed for day-to-day operation and management of each system. The maintenance manual shall describe equipment inventory and support the maintenance program.
7. A requirement for submittal of record drawings and control documents as a condition of final acceptance, per 780 CMR 116.0.

1301.8.4.2 Approval: Approval by the building official of the design concepts, testing procedures, and acceptance criteria of 780 CMR 1301.8.4.1, 1. through 7., is not required, but the building official shall reject the construction documents if these sections are incomplete, or if they specify any design elements that violate other requirements of 780 CMR.

1301.8.4.3 Design: All HVAC, lighting, and electric power distribution systems including sequence of operation, controls and supporting documentation shall be designed and specified by a qualified Registered Professional Engineer except as provided in M.G.L. c. 143, § 54A and any profession or trade as provided in M.G.L. c. 112, § 60L and M.G.L. c. 112, § 81R. The Registered Professional Engineer(s) or other legally recognized professional (M.G.L. c. 112, § 81R) shall be responsible for the review and certification that all submittals and shop drawings conform to the approved HVAC, lighting, and electric power distribution construction documents as submitted for the building permit and approved by the building official, per 780 CMR 116.0.

1301.8.4.4 Acceptance: In accordance with the provisions of 780 CMR 120, a certificate of occupancy shall not issue until the building official or his designees have witnessed a satisfactory test of all HVAC, lighting control, and electric power distribution systems installed in accordance with the construction documents. All systems shall be tested in accordance with the applicable standards of 780 CMR and documents. In addition, the following documents shall be simultaneously submitted to the building official prior to the issuance of a permanent certificate of occupancy.

1. Certification from the Registered Professional, as allowed in 780 CMR 116.2, stating that the HVAC, lighting, and electric power distribution systems have been installed in substantial accord with the approved construction documents.
2. Confirmation by the building owner/ developer or authorized representative that they have received all HVAC, lighting, and electric power distribution system record drawings from the installing contractors and that the Registered Professional Engineer or other legally recognized professional (M.G.L. c. 112, § 81R) has reviewed their reasonable accuracy.
3. Confirmation by the building owner/ developer or authorized representative that they have received all construction documents required in 780 CMR 1301.8.4.1

including reports, controls documentation, operation manual(s) and maintenance manual(s).

Exception: In lieu of witnessing a satisfactory functional test, the building official or their designees may accept a final performance acceptance test report from a Registered Professional Engineer or other legally recognized professional (M.G.L. c. 112, § 81R). Said report shall certify that the systems have been tested and satisfactorily meet their performance requirements.

1301.8.4.5 Unsafe Lighting and Ventilation: The *building official* may require or accept the documentation required in 780 CMR 1301.8.4.4 in enforcing the provisions of 780 CMR 3400.6.

1301.8.4.6 Conditional Acceptance: The requirements of 780 CMR 1301.8.4.4 shall not preclude the issuance of a temporary certificate of occupancy by the Building Official in accordance with 780 CMR 120.3 as long as it can be demonstrated that compliance can be accomplished with the building occupied.

1301.9 Materials and Equipment

1301.9.1 Identification: Where practicable, all materials and equipment referenced in 780 CMR 1301.8 shall be marked in order to show compliance with 780 CMR 13.

1301.9.2 Maintenance Information: Service systems which require preventive maintenance to maintain efficient operation shall be furnished with complete necessary maintenance information. Required routine maintenance actions, as specified by the manufacturer, shall be stated clearly and incorporated on a readily accessible label on the equipment. Such label may be limited to identifying, by title or publication number, the operation and maintenance manual for that particular model and type of product.

1301.9.3 Fenestration and Doors: Product samples used for determining *fenestration* performance shall be production line units or representative of units as purchased by the consumer or contractor.

1301.9.3.1 U-Factor: *U-factors* shall be determined in accordance with AAMA 1503 or NFRC 100. *U-factors* for *skylights* shall be determined in accordance with NFRC 100. *U-factor* shall be determined by an independent laboratory accredited by a nationally recognized accreditation organization and shall be certified by the manufacturer.

Exceptions: If a manufacturer of windows, window systems, skylights, glazed or unglazed door has not determined product U-value in accordance with 1301.9.3.1, compliance with the requirements of 780 CMR 13 shall be determined only by assigning such products a default U-value in accordance with Table 1301.9.3.1a or 1301.9.3.1b. Product features must be verifiable for the product to qualify for the default value associated with those features. Where existence of a particular feature cannot be determined with reasonable certainty, the product shall not receive credit for that feature. Where a composite of materials from two different product types is used, the product shall be assigned the higher U-value.

For garage doors, NAGDM 105 shall be an acceptable alternate for determining U Factor.

Table 1301.9.3.1a
U-Value Default Table for Windows, Curtain Walls, and Skylights[a]

Frame Material and Product Type[b]	Single Glazed	Double Glazed	Double Glazed Low-e[c]	Triple Glazed	Triple Glazed Low-e[c]
Metal without Thermal Break					
Windows	1.27	0.87	0.79	0.72	0.69
Curtain Walls	1.22	0.79	0.70	0.63	0.59
Skylight	1.98	1.31	1.20	1.12	1.08
Site-assembled sloped/overhead glazing	1.36	0.82	0.71	0.64	0.60
Metal with Thermal Break					
Windows	1.07	0.63	0.54	0.48	0.44
Curtain Walls	1.11	0.68	0.59	0.52	0.48
Skylight	1.89	1.11	1.00	0.89	0.85
Site-assembled sloped/overhead glazing	1.25	0.70	0.60	0.53	0.49
Wood/Vinyl/Fiberglass					
Windows	0.98	0.56	0.48	0.41	0.37
Skylight	1.47	0.84	0.74	0.64	0.59

[a] Certain values in this table do not meet the limits of 780CMR 1304.2, Prescriptive Building Envelope Criteria, or 780 CMR 1305, Building Envelope Trade-Off Option, and may be used only when demonstrating compliance using 780CMR 1309, Building Design by Systems Analysis.

[b] Glass block assemblies with mortar but without reinforcing or framing shall have a default value of 0.60.

[c] Presence of low-e coating must be certified in writing by the manufacturer.

Table 1301.9.3.1b
U-value Default Table for Doors

Door Type	
Opaque	0.70
Glass	0.92
Air Lock Entry	0.50
Revolving	0.50
Overhead	1.45

1301.9.3.2 Solar Heat Gain Coefficient: Solar heat gain coefficient (SHGC) for the overall fenestration area shall be determined in accordance with NFRC 200. Solar heat gain coefficient shall be determined by an independent laboratory accredited by a nationally recognized accreditation organization and shall be certified by the manufacturer.

Exception: If a manufacturer of windows, window systems, skylights, glazed or unglazed door has not determined product Solar Heat Gain Coefficient in accordance with 780 CMR 1301.9.3.2, compliance with the requirements of 780 CMR 13 shall be determined only by assigning such products a default SHGC in accordance with Table 1301.9.3.2. Credit for low-e coating may be taken only if presence of such coating is certified in writing by the manufacturer.

1301.9.3.3 Visible Light Transmittance: When 780 CMR 1304.5 is used with daylighting credit, visible light transmittance shall be determined in accordance with NFRC 200. Visible light transmittance shall be determined by an independent laboratory accredited by a nationally recognized accreditation organization and shall be certified by the manufacturer.

Exception: If a manufacturer of windows, window systems, skylights, glazed or unglazed door has not determined product Visible Light Transmittance in accordance with 780 CMR 1301.9.3.3, compliance with the requirements of 780 CMR 13 shall be determined only by assigning such products a default VLT in accordance with Table 1301.9.3.2. Credit for low-e coating may be taken only if presence of such coating is certified in writing by the manufacturer.

Table 1301.9.3.2
SHGC and VLT Default Table for Fenestration[a]

Glass Type	Metal Frame		Non-Metal Frame	
	SHGC	VLT	SHGC	VLT
Single Glazed				
Clear	0.78	0.80	0.76	0.78
Tinted	0.67	0.61	0.65	0.59
Reflective	0.53	0.37	0.52	0.36
Double Glazed				
Clear	0.68	0.72	0.66	0.70
Tinted	0.57	0.55	0.56	0.54
Reflective	0.46	0.32	0.45	0.31
Double Glazed Low-e				
Clear	0.64	0.68	0.63	0.66
Tinted	0.59	0.50	0.58	0.49
Reflective	0.46	0.32	0.45	0.31
Triple Glazed				
Clear	0.61	0.66	0.60	0.64
Tinted	0.42	0.22	0.41	0.22
Reflective	0.36	0.25	0.35	0.25
Triple Glazed Low-e				
Clear	0.57	0.61	0.56	0.59
Tinted	0.42	0.33	0.41	0.32
Reflective	0.36	0.25	0.35	0.25

[a] Presence of low-e coating must be certified in writing by the manufacturer.

780 CMR 1302.0 DEFINITIONS

1302.1 Meaning: Unless otherwise expressly stated, the following terms shall, for the purpose of 780 CMR Chapter 13, have the meaning indicated below.

1302.2 Tense, Gender and Number: Words used in the present tense include the future; words used in the masculine gender include the feminine and neuter; the singular number includes the plural and the plural the singular.

1302.3 Terms not Defined: Where terms are not defined, they shall have their ordinarily accepted meanings or such as the context may imply. Any terms relating to plumbing and electrical wiring shall have their terms as defined by the Regulations of the Commonwealth of Massachusetts pertaining to plumbing and electrical wiring.

Accessible (as Applied to Equipment): Admitting close approach because not guarded by locked doors, elevation or other effective means (see "Readily accessible").

Air Conditioning, Comfort: The process of treating air so as to control simultaneously its temperature, humidity, cleanliness, and distribution to meet requirements of the conditioned space.

Air Transport Factor: The ratio of the rate of useful sensible heat removal from the conditioned space to the energy input to the supply and return fan motor(s), expressed in consistent units and under the designated operating conditions.

Automatic: Self-acting, operating by its own mechanism when actuated by some impersonal influence, as, for example, a change in current strength, pressure, temperature or mechanical configuration (see "Manual").

Ballast: A device used in conjunction with an electric-discharge lamp to cause the lamp to start and operate under the proper circuit conditions of voltage, current, wave form, electrode heat, etc.

Electronic Ballast: A ballast constructed using electronic circuitry.

Hybrid Ballast: A ballast constructed using a combination of magnetic core and insulated wire winding and electronic circuitry.

Magnetic Ballast: A ballast constructed with magnetic core and a winding of insulated wire.

Below-grade Wall: The opaque portion of a wall which encloses one side of a basement and is partially or totally below grade.

Boiler: An appliance designed to heat water or generate steam (see "Packaged boiler".)

Building Area: The greatest horizontal area of a building above grade within the outside surface of exterior walls or within the outside surface of exterior wall and the center line of fire walls.

Building Envelope: The elements of a building which enclose conditioned spaces through which thermal energy may be transferred to or from the exterior or to or from unconditioned spaces or other spaces exempted by the provisions of 780 CMR 1301.7.

Building Entrance: Any doorway, set of doors, turnstiles, or other form of portal that is ordinarily used to gain access to the building by its users and occupants.

Building Grounds Lighting: Lighting provided through a building's electrical service for parking lot, site, roadway, pedestrian pathway, loading dock, and security applications.

Building Project: A building or group of buildings, including on-site energy conversion or electric-generating facilities, which utilize a single submittal for a construction permit or are within the boundary of a contiguous area under one ownership.

Coefficient of Performance (COP) - Heat Pump - Heating: The ratio of the rate of heat delivered to the rate of energy input, in consistent units, for a complete heat pump system under designated operating conditions.

Comfort: The physical conditions represented in the area on a psychometric chart enclosing all those conditions described in Figure 1 in ASHRAE 55, as listed in *Appendix A*, as being comfortable.

Commercial Building: For purposes of energy conservation, a commercial building is any building other than a low-rise residential building, as defined in 780 CMR J2.0.

Conditioned Floor Area: The horizontal projection of that portion of interior space which is contained within exterior walls and which is conditioned directly or indirectly by an energy-using system.

Conditioned Pace: Space within a building which is provided with positive heat supply (see definition), or which has heated and/or cooled air or surfaces, or where required, with humidification or dehumidification means so as to be capable of maintaining a space condition falling within the comfort zone set forth in ASHRAE 55, as listed in *Appendix A*.

Continuous Insulation (ci): Insulation that is continuous across all structural members without any thermal bridges, excluding fasteners and service openings. It is installed on the interior, exterior, or integral to any opaque surface of the building envelope.

Control Device: A specialized device used to regulate the operation of equipment.

Dead Band: The temperature range in which no heating or cooling is used.

Degree Day, Cooling (CDD): A unit, based upon temperature difference and time, used in estimating cooling energy consumption. For any one day, when the mean temperature is more than 65°F, there are as many degree days as degrees Fahrenheit temperature difference between the mean temperature for the day and 65°F. Annual Cooling Degree Days (CDD) are the sum of the degree days over a calendar year.

Degree Day, Heating (HDD): A unit, based upon temperature difference and time, used in estimating fuel consumption and specifying nominal heating load of a building in winter. For any one day, when the mean temperature is less than 50°F, there exists as many degree days as there are Fahrenheit degrees difference in temperature between the mean temperature for the day and 50°F. Annual Heating Degree Days (HDD) are the sum of the degree days over a calendar year.

Design Conditions: Specified environmental conditions, such as temperature and light intensity, required to be produced and maintained by a system and under which the system must operate.

Direct Digital Control (DDC): A type of control where controlled and monitored analog or binary data (e.g., temperature, contact closures) are converted to digital format for manipulation and calculations by a digital computer or microprocessor, then converted back to analog or binary form to control physical devices.

Distribution System: Conveying means, such as ducts, pipes, and wires, to bring substances or energy from a source to the point of use. The distribution system includes such auxiliary equipment as fans, pumps, and transformers.

Door: All operable opening areas (which are not fenestration) in the building envelope, including swinging and roll-up doors, fire doors, and access hatches. Doors that are more than one-half glass are considered fenestration. (See Fenestration.) For the purposes of determining building envelope requirements, the classifications are defined as follows:

> **Non-swinging**: Roll-up, sliding, and all other doors that are not swinging doors.
>
> **Swinging**: All operable opaque panels with hinges on one side and opaque revolving doors.

Door Area: Total area of the door measured using the rough opening and including the door slab and the frame. (See "Fenestration area.")

Economizer, Air: A duct and damper arrangement and automatic control system that together allows a cooling system to supply outside air to reduce or eliminate the need for mechanical cooling during mild or cold weather.

Economizer, Water: A system by which the supply air of a cooling system is cooled indirectly with water that is itself cooled by heat or mass transfer to the environment without the use of mechanical cooling.

Efficiency: Performance at specified rating conditions.

Efficiency, HVAC System: The ratio of useful energy output (at the point of use) to the energy input in consistent units for a designated time period, expressed in percent.

Emergency Power System: A system that operates in the event of primary system failure or provides power to essential loads during power supply outages.

Enclosed Space: A volume substantially surrounded by solid surfaces such as walls, floors, roofs, and openable devices such as doors and operable windows.

Enclosure: The case or housing of an apparatus, or the fence or walls surrounding an installation, to prevent personnel from accidentally contacting energized parts or protect equipment from physical damage.

Energy: The capacity for doing work taking a number of forms which may be transformed from one into another, such as thermal (heat), mechanical (work), electrical and chemical in customary units, measured in kilowatt-hours (kWh) or British thermal units (Btu).

Energy Efficiency Ratio (EER): The ratio of net equipment cooling capacity in Btu/h to total rate of electric input in watts (W) under designated operating conditions. If the output capacity in Btu/h is converted to watts (to create consistent units) the result is equal to the cooling COP (EER 3.41 = COP.) See also Coefficient of Performance.

Energy, Recovered: (See "Recovered energy.")

Exfiltration: The uncontrolled outward air leakage through cracks and interstices in any building element and around windows and doors of a building caused by the pressure effects of wind and/or the effect of differences in the indoor and outdoor air density.

Existing Buildings: For purposes of energy conservation, and existing building which has been legally occupied and/or used for a period of at least five years. (Also see 780 CMR 2.0 and 780 CMR 3400.3.1.)

Exterior Lighting Power Allowance: (See "Lighting power allowance.")

Facade Area, Vertical: Area of the facade, including nonhorizontal roof area, overhangs, and cornices, measured in elevation in a vertical plane parallel to the plane of the face of the building.

F-factor: The perimeter heat loss factor for slab-on-grade floors, expressed in Btu/h*ft*°F.

Fan System Energy Demand (or Fan System power): The sum of the nominal power demand (nameplate horsepower) of motors of all fans that are required to operate at design conditions to supply air from the heating or cooling source to the conditioned space(s) and return it to the source or exhaust it to the outdoors.

Fenestration: All areas (including the frames) in the building envelope that let in light, including windows, plastic panels, clerestories, skylights, glass doors that are more than one-half glass, and glass block walls. (See Building envelope and Door.)

Skylight: A fenestration surface having a slope of less than 60° from the horizontal plane. Other fenestration, even if mounted on the roof of a building, is considered vertical fenestration.

Vertical Fenestration: All fenestration other than skylights.

Fenestration Area: Total area of the fenestration measured using the rough opening and including the glazing, sash, and frame. For doors where the glazed vision area is less than 50% of the door area, the fenestration area is the glazed vision area. For all other doors, the fenestration area is the door area. (See "Door area.")

Fenestration, Vertical: (See "Fenestration" and "Skylight.")

Fixture: The component of a luminaire that houses the lamp or lamps, positions the lamp, shields it from view, and distributes the light. The fixture also provides for connection to the power supply, which may require the use of a ballast.

Floor: That lower portion of the building envelope, including opaque area and fenestration, that has conditioned or semiheated space above and is horizontal or tilted at an angle of less than 60 degrees from horizontal but excluding slab-on-grade floors. For the purposes of determining building envelope requirements, the classifications are defined as follows:

Mass Floor: A floor with a heat capacity that exceeds (1) seven Btu/ft^2*°F or (2) five Btu/ft^2*°F provided that the floor has a material unit weight not greater than 120 lb/ft^3.

Steel Joist Floor: A floor that (1) is not a mass floor and (2) which has steel joist members supported by structural members.

Wood Framed and Other Floors: All other floor types, including wood joist floors.

(See "Building envelope", "Fenestration", "Opaque area", and "Slab-on-grade floor.")

Floor Area, Gross: The sum of the floor areas of the spaces within the building including basements, mezzanine and intermediate-floored tiers, and penthouses with headroom height of 7.5 ft (2.3 m) or greater. It is measured from the exterior faces of exterior walls or from the centerline of walls separating buildings, but excluding covered walkways, open roofed-over areas, porches and similar spaces, pipe trenches, exterior terraces or steps, chimneys, roof overhangs, and similar features.

Gross Building Envelope Floor Area: The gross floor area of the building envelope, but excluding slab-on-grade floors.

Gross Conditioned Floor Area: The gross floor area of conditioned spaces.

Gross Lighted Floor Area: The gross floor area of lighted spaces.

Gross Semiheated Floor Area: The gross floor area of semiheated spaces.

(See "Building envelope", "Floor", "Slab-on-grade floor," and "Space.")

Flue Damper: A device in the flue outlet or in the inlet of or upstream of the draft control device of an individual, automatically operated, fossil fuel-fired appliance that is designed to automatically open the flue outlet during appliance operation and to automatically close the flue outlet when the appliance is in a standby condition.

Fossil Fuel: An organic material, other than wood, used as a fuel.

Footcandle (fc): The illuminance on a surface one ft^2 in area on which there is a uniformly distributed flux of one lm, or the illuminance produced on a surface all points of which are at a distance of one ft from a directionally uniform point source of 1 cd. (For SI users, one footcandle equals 10.76 lux.)

Furnace, Duct: A furnace normally installed in distribution ducts of air conditioning systems to supply warm air for heating and which depends on a blower not furnished as part of the duct furnace for air circulation.

Furnace, Warm Air: A self-contained, indirect-fired or electrically heated furnace that supplies heated air through ducts to spaces that require it.

Glazed Wall System: A category of site assembled fenestration products used in the NFRC 100 and NFRC 200 rating procedures which includes, but is not limited to, curtainwalls and solariums.

Grade: The finished ground level adjoining a building at all exterior walls.

Glazing Area: Interior surface area of all glazed surfaces (such as windows, sliding glass doors, skylights, etc.), sash, curbing, jambs, or other framing elements that enclose conditioned spaces.

Gross Area of Exterior Walls: The normal projection of the building envelope wall area bounding interior space which is conditioned by an energy-using system including opaque wall, window and door area.

The gross area of exterior walls consists of all opaque wall areas, including between floor spandrels, peripheral edges of floors, roof and basement knee walls, walls enclosing a mansard roof, window areas including sash, and door areas when such surfaces are exposed to outdoor air, unconditioned spaces, or mechanically cooled space, including interstitial areas between two such spaces. For each basement wall that encloses heated space, if the average below-grade area is less than 50% of the total area for that wall, including openings, the entire wall, including the below-grade portion is included as part of the gross area of exterior walls. Non-opaque areas (windows, doors, etc.) of all basement walls are included in the gross area of exterior walls. (Note: if the basement is not heated space, and if the basement ceiling is insulated, then the basement walls are not included in the gross area of exterior walls.

Gross floor area: The sum of the areas of the several floors of the building, including basements, cellars, mezzanine and intermediate floored tiers and penthouses of headroom height, measured from the exterior faces of exterior walls or from the center line of walls separating buildings, but excluding:

1. covered walkways, open roofed-over areas, porches and similar spaces.
2. pipe trenches, exterior terraces or steps, chimneys, roof overhangs and similar features.

Heat: The form of energy that is transferred by virtue of a temperature difference or a change in state of a material.

Heated Space: Space within a building which is provided with a positive heat supply. Space within a basement with registers or heating devices designed to supply heat to a basement space shall automatically define that space as heated space.

Humidistat: An automatic control device used to maintain humidity at a fixed or adjustable set point.

HVAC: Heating, ventilating, and air conditioning.

HVAC System: The equipment, distribution network, and terminals that provide either collectively or individually the processes of heating, ventilating, or air conditioning to a building.

HVAC System Components: HVAC system components provide, in one or more factory-assembled packages, means for chilling and/or heating water with controlled temperature for delivery to terminal units serving the conditioned spaces of the building. Types of HVAC system components include, but are not limited to, water chiller packages, reciprocating condensing units and water source (hydronic) heat pumps (See "HVAC system equipment").

HVAC System Efficiency: (See "Efficiency, HVAC system.")

HVAC System Equipment: HVAC system equipment provides, in one (single package) or more (split system) factory-assembled packages, means for air circulation, air cleaning, air cooling with controlled temperature and dehumidification, and, optionally, either alone or in combination with a heating plant, the functions of heating and humidifying. The cooling function may be either electrically or heat operated and the refrigerant condenser may be air, water or evaporatively cooled. Where the equipment is provided in more than one package, the separate packages shall by designed by the manufacturer to be used together. The equipment may provide the heating function as a heat pump or by the use of electric or fossil-fuel-fired elements. (The word "equipment" used without modifying adjective may, in accordance with common industry usage, apply either to HVAC system equipment or HVAC system components.)

Indirectly Conditioned Space: (See "Space.")

Infiltration: The uncontrolled inward air leakage through cracks and interstices in any building element and around windows and doors of a building caused by the pressure effects of wind and/or the effect of differences in the indoor and outdoor air density.

Installed Interior Lighting Power: The power in watts of all permanently-installed general, task, and furniture lighting systems and luminaires as indicated on plans and specifications.

Integrated Part-load Value (IPLV): A single number figure of merit based on part-load EER or COP expressing part-load efficiency for air-conditioning and heat pump equipment on the basis of weighted operation at various load capacities for the equipment.

Interior Lighting Power Allowance: (See "Lighting power allowance.")

Isolation Devices: Devices that isolate HVAC zones so that they can be operated independently of one another. Isolation devices include, but are not limited to, separate systems, isolation dampers, and controls providing shutoff at terminal boxes.

Lighting Power Allowance:

Interior Lighting Power Allowance: The maximum lighting power in watts allowed for the interior of a building.

Exterior Lighting Power Allowance: The maximum lighting power in watts allowed for the exterior of a building.

Lighting Power Density (LPD): The maximum lighting power per unit area of a building classification of space function.

Low-rise Residential Buildings: Residential occupancy buildings (R-2, R-3, R-4, or R-5) three stories or less in height. (Exception: For purposes of energy conservation, R-1 use group buildings shall be treated as commercial buildings as defined in 780 CMR J2.0.)

Lumen (lm): The luminous flux emitted within a unit solid angle (one steradian) by a point source having a uniform luminous intensity of one cd.

Luminaire: A complete lighting unit consisting of a lamp or lamps together with the housing designed to distribute the light, position and protect the lamps, and connect the lamps to the power supply.

Manufacturer: The company engaged in the original production and assembly of products or equipment or a company that purchases such products and equipment manufactured in accordance with company specifications.

Manual: Capable of being operated by personal intervention (See "Automatic.")

Multi-family dwelling: A building containing three or more dwelling units.

Net Area of Exterior Walls: The gross area of exterior walls, minus the total rough opening area of all windows and doors set in the exterior walls.

Nondepletable Energy Sources: Sources of energy (excluding minerals and solid fuels) derived from incoming solar radiation, including natural daylighting and photosynthetic processes; from phenomena resulting therefrom, including wind, waves and tides, lake or pond thermal differences; and from the internal heat of the earth, including nocturnal thermal exchanges.

Nonrecirculating System: A domestic or service hot water distribution system that is not a recirculating system.

Occupant Sensor: A device that detects the presence or absence of people within an area and causes lighting, equipment, or appliances to be regulated accordingly.

Opaque Areas: All exposed areas of a building envelope which enclose conditioned space, except openings for windows, skylights, doors and building service systems.

Outdoor Air: Air taken from the outdoors, (i.e. - not previously circulated through the HVAC system.)

Packaged Boiler: A boiler that is shipped complete with heating equipment, mechanical draft equipment, and automatic controls; usually shipped in one or more sections.

Plenum: An enclosure that is part of the air distribution system and is distinguished by having almost uniform air pressure. A plenum often is formed in part or in total by portions of the building.

Pool: A body of non-potable water contained in a human-made structure intended and large enough for substantial immersion of one or more people. The term includes but is not limited to swimming pool, whirlpool, spa, hot tub.

Positive Heat Supply: Heat deliberately supplied to a space by design, such as a supply register, radiator or heating element. Also, heat indirectly supplied to a space through uninsulated surfaces of service water heaters and space heating components, such as furnaces, boilers and heating and cooling distribution systems which continually maintain air temperature within the space of 50°F. or higher during normal operation.

Projection Factor (PF): The ratio of the horizontal depth of the external shading projection divided by the sum of the height of the fenestration and the distance from the top of the fenestration to the bottom of the farthest point of the external shading projection, in consistent units.

Proposed Design: A description of the proposed building design used to estimate annual energy costs for determining compliance based on 780 CMR 1309.

Rated R-value of Insulation: The thermal resistance of the insulation alone as specified by the manufacturer according to recognized trade and engineering standards in units of h*ft2*°F/Btu at a mean temperature of 75°F. Rated R-value refers to the thermal resistance of the added insulation in framing cavities or insulated sheathing only and does not include the thermal resistance of other building materials or air films. (See "Thermal resistance.")

Readily Accessible: Capable of being reached quickly for operation, renewal or inspections, without requiring those to whom ready access is requisite to climb over or remove obstacles or to resort to portable ladders or access equipment (see "Accessible.")

Recooling: The removal of heat by sensible cooling of the supply air (directly or indirectly) that has been previously heated above the temperature to which the air is to be supplied to the conditioned space for proper control of the temperature of that space.

Record Drawings: Drawings that record the conditions of the project as constructed. These include any refinements of the construction or bid documents.

Recovered Energy: Energy utilized which would otherwise be wasted (i.e., not contribute to a desired end use) from an energy utilization system.

Reheat: The application of sensible heat to supply air that has been previously cooled below the temperature of the conditioned space by either mechanical refrigeration or the introduction of outdoor air to provide cooling.

Reset: Adjustment of the set point of a control instrument to a higher or lower value automatically or manually to conserve energy.

Roof Assembly: A roof assembly shall be considered as all components of the roof/ceiling envelope through which heat flows, thus creating a building transmission heat loss or gain, where such assembly is exposed to outdoor air and encloses a heated or mechanically cooled space.

The gross area of a roof assembly consists of the total interior surface of such assembly, including skylights exposed to the heated or mechanically cooled space.

Sequence: A consecutive series of operations.

Service Systems: All energy-using systems in a building that are operated to provide services for the occupants or processes housed therein, including HVAC, service water heating, illumination, transportation, cooking or food preparation, laundering and similar functions.

Service Water Heating: Supply of hot water for purposes other than space heating.

Setback: Reduction of heating (by reducing the set point) or cooling (by increasing the setpoint) during hours when a building is unoccupied or during periods when lesser demand is acceptable.

Slab-on-grade: A floor slab for which the top edge of the perimeter is above the finished grade or 12 inches or less below the finished grade.

Solar Energy Source: Source of natural daylighting and of thermal, chemical or electrical energy derived directly from conversion of incident solar radiation.

Solar Heat Gain Coefficient (SHGC): The ratio of the solar heat gain entering the space through the fenestration area to the incident solar radiation. Solar heat gain includes directly transmitted solar heat and absorbed solar radiation, which is then reradiated, conducted, or convected into the space. (See fenestration area.)

Standard Design: A version of the proposed design that meets the minimum requirements of 780 CMR 1300 and is used to determine the annual energy usage for determining compliance based on 780 CMR 1309.

System: A combination of central or terminal equipment or components and/or controls, accessories, interconnecting means, and terminal devices by which energy is transformed so as to perform a specific function, such as HVAC, service water heating or illumination.

Thermal Conductance (C): Time rate of heat flow through a body (frequently per unit area) from one of its bounding surfaces to the other for a unit temperature difference between the two surfaces, under steady conditions (Btu/h*ft*2*°F).

Thermal Resistance (R): The reciprocal of thermal conductance (h*ft*2*°F/Btu).

Thermal Resistance, Overall (Ro): The reciprocal of overall thermal conductance (h*ft*2*°F /Btu) [(m2.k)/W]. The overall thermal resistance of the gross area or individual component of the exterior building envelope (roof/ceiling, exterior wall, floor, crawl space wall, foundation, window, skylight, door, or opaque wall, etc.) which includes the weighted R-values of the component assemblies (such as air-film, insulation, drywall, framing, glazing, etc.).

Thermal Transmittance (U): The coefficient of heat transmission (air to air). It is the time rate of heat flow per unit area and unit temperature difference between the warm side and cold side air films (Btu/ h*ft*2*°F). The U-value applies to combinations of different materials used in series along the heat flow path, single materials that comprise a building section, cavity air spaces and surface air films on both sides of a building element. The term F-value applies to U properties for concrete slabs.

Thermal Transmittance, Overall (Uo): The overall (average) heat transmission of a gross area of the exterior building envelope (Btu/ h*ft*2*°F.) The Uo value applies to the combined effect of the time rate of heat flow through the various parallel paths, such as windows, doors and opaque construction areas, comprising the gross area of one or more exterior building components, such as walls, floors or roof/ceilings.

Thermostat: An automatic control device actuated by temperature and designed to be responsive to temperature.

Thermostatic Control: An automatic control device or system used to maintain temperature at a fixed or adjustable set point.

Transformer: A piece of electrical equipment used to convert electric power from one voltage to another voltage.

Dry-type Transformer: A transformer in which the core and coils are in a gaseous or dry compound.

Liquid-immersed Transformer: A transformer in which the core and coils are immersed in an insulating liquid.

Unitary Cooling and Heating Equipment: One or more factory-made assemblies which include an evaporator or cooling coil, a compressor and condenser combination, and may include a heating function as well. When heating and cooling equipment is provided in more than one assembly, the separate assemblies shall be designed to be used together.

Unitary Heat Pump: One or more factory-made assemblies which include an indoor conditioning coil, compressor(s) and outdoor coil or refrigerant-to-water heat exchanger, including means to provide both heating and cooling functions. When heat pump equipment is provided in more than one assembly, the separate assemblies shall be designed to be used together.

Variable Air Volume (VAV) System: HVAC system that controls the dry-bulb temperature within a space by varying the volumetric flow of heated or cooled supply air to the space.

Vent Damper: A device intended for installation in the venting system of an individual, automatically-operated, fossil fuel fired appliance in the outlet or downstream of the appliance draft control device which is designed to automatically open the venting system when the appliance is in operation and to automatically close off the venting system when the appliance is in a standby or shutdown condition.

Ventilation: The process of supplying or removing air by natural or mechanical means to or from any space. Such air may or may not have been conditioned.

Ventilation Air: That portion of supply air which comes from outside (outdoors) plus any recirculated air that has been treated to maintain the desired quality of air within a designated space. (See BOCA Mechanical Code, as listed in *Appendix A*, 780 CMR J3, and definition of "Outdoor air.")

Voltage Drop: A decrease in voltage caused by losses in the lines connecting the power source to the load.

Wall: That portion of the building envelope, including opaque area and fenestration, that is vertical or tilted at an angle of 60° from horizontal or greater. This includes above- and below-grade walls, between floor spandrels, peripheral edges of floors, and foundation walls. For the purposes of determining building envelope requirements, the classifications are defined as follows:

Above-grade Wall: A wall that is not a below-grade wall.

Below-grade Wall: That portion of a wall in the building envelope that is entirely below the finish grade and in contact with the ground.

Metal Building Wall: a wall whose structure consists of metal spanning members supported by steel structural members (i.e., does not include spandrel glass or metal panels in curtain wall systems).

Steel Framed Wall: A wall with a cavity (insulated or otherwise) whose exterior surfaces are separated by steel framing members (i.e., typical steel stud walls and curtain wall systems).

Wood Framed and Other Walls: All other wall types, including wood stud walls.

Wall Area, Gross: The area of the wall measured on the exterior face from the top of the floor to the bottom of the roof.

Water Heater: Closed vessel in which water is heated by the combustion of fuels, electricity, or any other source and is withdrawn for use external to the system at pressures not exceeding 160 psig, including the apparatus by which heat is generated and all controls and devices necessary to prevent water temperatures from exceeding 210°F.

Zone: A space or group of spaces within a building with heating and/or cooling requirements sufficiently similar so that comfort conditions can be maintained throughout by a single controlling device.

780 CMR 1303.0 DESIGN CONDITIONS

1303.1 Scope: 780 CMR 1303.0 applies to all buildings.

1303.2 General: The criteria of 780 CMR 1303.0 establishes the minimum requirements for the thermal design of the exterior envelope of buildings and for HVAC systems and equipment.

1303.3 Design Parameters: The design parameters listed in Tables 1303.1 and 1303.2 shall be used for calculations required under 780 CMR 13.

1303.3.1 Interior Design Conditions: Indoor design temperature and relative humidity shall be determined in accordance with ASHRAE Standard 55-92 listed in *Appendix A*, and shall be selected for minimum total HVAC system energy use in accordance with accepted practice.

Exception: Buildings or portions of buildings which require different temperatures and humidity, such as, but not limited to, hospitals, laboratories, museums, art galleries, supermarkets, thermally sensitive equipment rooms, archival storage facilities, and facilities for the elderly, may require the use of alternative indoor design conditions. Any such use of alternative indoor design conditions shall be documented by a licensed professional.

1303.4 Ventilation: Ventilation air shall conform to the requirements specified in 780 CMR 2801.0.

Table 1303.1
CLIMATE ZONE BY COUNTY

County	Climate Zone #
Barnstable	12a
Berkshire	14a
Bristol	12a
Dukes	12a
Essex	13a
Franklin	14a
Hampden	14a
Hampshire	14a
Middlesex	13a
Nantucket	12a
Norfolk	13a
Plymouth	12a
Suffolk	13a
Worcester	14a

Table 1303.2
CLIMATE ZONE THERMAL DESIGN CRITERIA

Climate Zone #	12a	13a	14a
Heating Degrees (°F) Winter	9	7	-1
Cooling Degrees (°F) Dry Bulb Summer	86	87	86
Cooling Degrees (°F) Wet Bulb Summer	74	74	73
Heating Degree Days Base 65	5884	5641	6894
Heating Degree Days Base 50	2553	2399	3448
Cooling Degree Days Base 65	606	678	507
Cooling Degree Days Base 50	2743	2897	2525
Cooling Degree Hours Base 80	939	1299	409

780 CMR 1304.0 BUILDING ENVELOPE REQUIREMENTS

1304.1 General: Walls, roof assemblies, floors, glazing, and floor slabs which are part of the building envelope shall meet the requirements of 780 CMR 1304.1, 1304.3, 1304.4 and either:

1. 780 CMR 1304.2, Prescriptive Building Envelope Criteria, provided that:
   a. the building is less than four stories in height above grade;
   b. the vertical fenestration area does not exceed 50% of the gross wall area for each space conditioning category; and,
   c. the skylight fenestration area does not exceed 3% of the gross roof area for each space-conditioning category; or,
2. 780 CMR 1304.5, Building Envelope Trade-off Option.

1304.1.1 Classification of Walls: Walls associated with the building envelope shall be classified in accordance with 780 CMR 1304.1.1.1, 1304.1.1.2 or 1304.1.1.3.

1304.1.1.1 Above-grade Walls: Above-grade walls are those walls covered by 780 CMR 1304.2.1 on the exterior of the building and completely above grade or the above-grade portion of a basement or first-story wall that is more than 15% above grade.

1304.1.1.2 Below-grade Walls: Below-grade walls covered by 780 CMR 1304.2.9 are basement or first-story walls associated with the exterior of the building that are at least 85% below grade.

1304.1.1.3 Interior Walls: Interior walls covered by 780 CMR 1304.2.10 are those walls not on the exterior of the building and that separate conditioned and unconditioned space.

1304.1.2 Moisture Control: The design of buildings for energy conservation shall not create conditions of accelerated deterioration from moisture condensation.

A vapor barrier having a maximum permeability of zero point one (0.1) perm or less, per Chapter 24 in 1997 ASHRAE Fundamentals Handbook, (equivalent to a 4 mil polyethylene sheet) shall be installed on the winter warm side of walls, ceilings and floors enclosing a conditioned space. Batt/blanket insulation with a vapor barrier attached shall be attached to the winter warm sides or faces of wall studs, sole plates, top plates, lintels and headers at intervals of eight inches on center to prevent convection loops through the insulation. Where batt/blanket insulation is of a "friction fit" design and a sheet vapor barrier is employed, the vapor barrier shall be affixed to the interior face of the wall studs, sole plates, top plates, lintels and headers winter warm side in accordance with the vapor barrier manufacturer's recommendations. All joints, holes, imperfections and penetrations of the vapor barrier shall be taped tight with a vapor barrier tape recommended by the vapor barrier manufacturer.

All other envelope building materials and finishes installed towards the cooler, exterior side of the wall shall have water vapor permeability at least ten times greater than the interior vapor barrier material.

Exception 1: Materials to the exterior of a ventilated rainscreen cavity may have any permeability.

Exception 2: Envelope systems that maintain the temperature of potential condensing surfaces (typically the interface of exterior sheathing with cavity insulation) above the dewpoint temperature of the interior air. For calculation purposes use Chapter 22 in 1997 ASHRAE Fundamentals Handbook, "Steady State Design Tools." Assume steady-state heat transfer, interior air temperature and humidity specified in 780 CMR 1303.3, and exterior air temperature indicated as "Heating Degrees Winter" in Table 1303.2.

Exception 3: Envelope systems that maintain the moisture content of all building materials that comprise the assembly below the equilibrium moisture content the materials would achieve when exposed to relative humidity of 80%. For calculation purposes use Chapter 22 in 1997 ASHRAE Fundamentals Handbook, "Mathematical Models". Assume interior air temperature and humidity specified in 780 CMR 1303.3.

Exception 4: Pre-engineered metal buildings need not satisfy the requirement for ten times greater permeability on the exterior side of vapor retarders.

Buildings with unusual interior design conditions (such as continually refrigerated buildings, ice rinks, cold storage) shall demonstrate compliance by the method in Exception 3.

1304.2 Prescriptive Building Envelope Criteria: The building envelope components shall meet each of the applicable requirements in Tables 1304.2.1-12, based on the climate zone and the percentage of wall that is glazed. The climate zone shall be determined based on the county in accordance with 780 CMR 1302, Tables 1302.1 and 1302.2. The percentage of wall that is glazed shall be determined by dividing the aggregate area of rough openings or unit dimensions for fenestration (windows and glazed doors) in all the above grade walls associated with the building envelope by the total gross area of all above grade exterior walls that are part of the building envelope. In buildings with multiple types of building envelope construction, each building envelope construction type shall be evaluated separately.

1304.2.1 Above Grade Walls: The minimum thermal resistance (R-value) of the insulating material installed in the wall cavity between the framing members and continuously on the walls shall be as specified in Tables 1304.2.1-12 based on framing type and construction materials used in the wall assembly. Where both cavity and continuous insulation values are provided in Tables 1304.2.1-12, both requirements shall be met. Masonry walls shall be considered "framed walls" when weighing less than 35 psf of wall area.

1304.2.2 Non-glazed Doors: When the total area of non-glazed doors is greater than 5% of the total opaque wall area, the area of non-glazed doors above 5% shall be insulated as an opaque wall or an adjustment shall be made in the thermal resistance of the wall to address any thermal deficiency created by the doors.

1304.2.3 Windows and Glass Doors: The maximum solar heat gain coefficient (SHGC) and thermal transmittance (U-value) of window assemblies and glass doors located in the building envelope shall be as specified in Tables 1304.2.1-12 based on the window projection factor.

The window projection factor shall be determined in accordance with equation 1304.2.3.

Equation 1304.2.3

$$PF = A/B$$

Where:

PF= Projection factor (decimal).

A = Distance measured horizontally from the extremity of any overhang, eave, or permanently attached shading device to the vertical surface of the glazing.

B = Distance measured vertically from the bottom of the glazing to the underside of the overhang, eave, or permanently attached shading device.

Where different windows or glass doors have different PF values they shall each be evaluated separately or an area weighted PF value shall be calculated and used for all windows and glass doors.

1304.2.4 Roof Assembly: The minimum thermal resistance (R-value) of the insulating material installed either between the roof framing or continuously on the roof assembly shall be as specified in Tables 1304.2.1-12 based on construction materials used in the roof assembly.

1304.2.5 Skylights: Skylights located in the building envelope shall be limited to 3% of the gross roof assembly area and shall have a maximum thermal transmittance (U-value) of the skylight assembly as specified in Tables 1304.2.1-12.

1304.2.6 Floors Over Outdoor Air or Unconditioned Space: The minimum thermal resistance (R-value) of the insulating material installed either between the floor framing or continuously on the floor assembly shall be as specified in Tables 1304.2.1-12 based on construction materials used in the floor assembly.

1304.2.7 Slabs on Grade: The minimum thermal resistance (R-value) of the insulation around the perimeter of the slab floor on grade shall be R-5. The insulation shall be placed on the outside of the foundation or on the inside of the foundation wall. Insulation on the outside of the foundation wall shall extend downward from the top of the slab for a minimum of 48 in. Insulation on the inside of the foundation wall shall extend downward to at least the bottom of the slab and then horizontally for a minimum total distance of 48 in. In addition, the entire area of the slab on grade shall be insulated with a minimum of R-5 rigid insulation in the following buildings: buildings of use group E, including daycare; buildings of use groups R-1, R-2, I-1 and I-2, and; college and university buildings of B and A use groups.

Exception: For a monolithic slab on grade floor, the insulation shall extend from the top of the slab on grade to the bottom of the footing. Continuous under-slab insulation shall be provided per 1304.2.8.

1304.2.8 Slabs Below Grade: The entire area of a floor slab which is below grade and is in contact with the ground shall be insulated with a minimum of R-5 rigid insulation in the following buildings: buildings of use group E, including daycare; buildings of use groups R-1, R-2, I-1 and I-2, and; college and university buildings of B and A use groups.

1304.2.9 Below Grade Walls: The minimum thermal resistance of the insulating material installed in, or continuously on, below grade walls of conditioned spaces shall be R-5, and shall extend from the top of the wall to the depth of the bottom of the floor slab.

1304.2.10 Interior Walls: The minimum thermal resistance (R-value) of the insulating material installed in the wall cavity or continuously on the interior walls separating *conditioned space* from *unconditioned space* shall be as specified in Tables 1304.2.1, 1304.2.5, and 1304.2.9 for above grade walls, regardless of glazing area, based on framing type and construction materials used in the wall assembly.

TABLE 1304.2.1
BUILDING ENVELOPE REQUIREMENTS
Climate Zone 12a
Glazing Area 10% or less of Above Grade Wall Area

Above-Grade Walls:	Continuous Insulation (or average insulation value)*	Metal Framing (c.i. = continuous insulation)	Wood Framing
Framed or Masonry < 35 psf.	R-7	R-11 + R-3 c.i.	R-11
Masonry ≥ 35 psf.	R-5	R-11 + R-3 c.i.	R-11

Window Assemblies:	SHGC (maximum)	U-Value (maximum)
PF < 0.25	Any	Any
0.25 ≤ PF < 0.50	Any	Any
PF ≥ 0.50	Any	Any
Skylights - U-Value (maximum)	X	0.8

Roof Assemblies: (either/or)	Insulation Between Framing	Continuous Insulation
All-Wood Joist/Truss	R-19	R-16
Non-wood Joist/Truss	R-25	R-17
Concrete Slab or Deck	NA	R-16
Metal Purlin with Thermal Break	R-25	R-17
Metal Purlin w/o Thermal Break	X	R-17

Floor Assemblies: (either/or)	Insulation Between Framing	Continuous Insulation
All-Wood Joist/Truss	R-19	R-16
Non-wood Joist/Truss	R-19	R-16
Concrete Slab or Deck	NA	R-16
Slab, Perimeter, and Below-Grade Wall	R-5	

* For masonry walls, average R-value shall be calculated based on the assumption of isothermal planes, using methodology in 1997 ASHRAE Fundamentals Handbook, Chapter 22.

TABLE 1304.2.2
BUILDING ENVELOPE REQUIREMENTS
Climate Zone 12a
Glazing Area Over 10% but not greater than 25% of Above Grade Wall Area

Above-Grade Walls:	Continuous Insulation (or average insulation value)*	Metal Framing (c.i. = continuous insulation)	Wood Framing
Framed or Masonry < 35 psf.	R-7	R-11 + R-3 c.i.	R-11
Masonry ≥ 35 psf.	R-5	R-11 + R-3 c.i.	R-11

Window Assemblies:	SHGC (maximum)	U-Value (maximum)
PF < 0.25	0.6	0.6
0.25 ≤ PF < 0.50	0.7	0.6
PF ≥ 0.50	Any	0.6
Skylights - U-Value (maximum)	X	0.8

Roof Assemblies: (either/or)	Insulation Between Framing	Continuous Insulation
All-Wood Joist/Truss	R-25	R-19
Non-wood Joist/Truss	R-25	R-20
Concrete Slab or Deck	NA	R-19
Metal Purlin with Thermal Break	R-30	R-20
Metal Purlin w/o Thermal Break	X	R-20

Floor Assemblies: (either/or)	Insulation Between Framing	Continuous Insulation
All-Wood Joist/Truss	R-19	R-16
Non-wood Joist/Truss	R-19	R-16
Concrete Slab or Deck	NA	R-16
Slab, Perimeter, and Below-Grade Wall	R-5	

TABLE 1304.2.3
BUILDING ENVELOPE REQUIREMENTS
Climate Zone 12a
Glazing Area Over 25% but not greater than 40% of Above Grade Wall Area

Above-Grade Walls:	Continuous Insulation (or average insulation value)*	Metal Framing (c.i. = continuous insulation)	Wood Framing
Framed or Masonry < 35 psf.	R-7	R-11 + R-3 c.i.	R-11
Masonry ≥ 35 psf.	R-5	R-11 + R-3 c.i.	R-11

Window Assemblies:	SHGC (maximum)	U-Value (maximum)
PF < 0.25	0.5	0.5
0.25 ≤ PF < 0.50	0.6	0.5
PF ≥ 0.50	0.7	0.5
Skylights - U-Value (maximum)	X	0.8

Roof Assemblies: (either/or)	Insulation Between Framing	Continuous Insulation
All-Wood Joist/Truss	R-30	R-23
Non-wood Joist/Truss	R-30	R-24
Concrete Slab or Deck	NA	R-23
Metal Purlin with Thermal Break	X	R-24
Metal Purlin w/o Thermal Break	X	R-24

Floor Assemblies: (either/or)	Insulation Between Framing	Continuous Insulation
All-Wood Joist/Truss	R-19	R-16
Non-wood Joist/Truss	R-19	R-16
Concrete Slab or Deck	NA	R-16
Slab, Perimeter, and Below-Grade Wall	R-5	

* For masonry walls, average R-value shall be calculated based on the assumption of isothermal planes, using methodology in 1997 ASHRAE Fundamentals Handbook, Chapter 22.

TABLE 1304.2.4
BUILDING ENVELOPE REQUIREMENTS
Climate Zone 12a
Glazing Area Over 40% but not greater than 50% of Above Grade Wall Area

Above-Grade Walls:	Continuous Insulation (or average insulation value)*	Metal Framing (c.i. = continuous insulation)	Wood Framing
Framed or Masonry < 35 psf.	R-7	R-13 + R-3 c.i.	R-11
Masonry ≥ 35 psf.	R-5	R-11 + R-3 c.i.	R-11

Window Assemblies:	SHGC (maximum)	U-Value (maximum)
PF < 0.25	0.4	0.4
0.25 ≤ PF < 0.50	0.5	0.4
PF ≥ 0.50	0.7	0.4
Skylights - U-Value (maximum)	X	0.8

Roof Assemblies: (either/or)	Insulation Between Framing	Continuous Insulation
All-Wood Joist/Truss	R-30	R-23
Non-wood Joist/Truss	R-30	R-24
Concrete Slab or Deck	NA	R-23
Metal Purlin with Thermal Break	R-30	R-24
Metal Purlin w/o Thermal Break	R-38	R-24

Floor Assemblies: (either/or)	Insulation Between Framing	Continuous Insulation
All-Wood Joist/Truss	R-19	R-16
Non-wood Joist/Truss	R-19	R-16
Concrete Slab or Deck	NA	R-16
Slab, Perimeter, and Below-Grade Wall	R-5	

TABLE 1304.2.5
BUILDING ENVELOPE REQUIREMENTS
Climate Zone 13a
Glazing Area 10% or less of Above Grade Wall Area

Above-Grade Walls:	Continuous Insulation (or average insulation value)*	Metal Framing (c.i. = continuous insulation)	Wood Framing
Framed or Masonry < 35 psf.	R-7	R-13 + R-3 c.i.	R-11
Masonry ≥ 35 psf.	R-5	R-11 + R-3 c.i.	R-11

Window Assemblies:	SHGC (maximum)	U-Value (maximum)
PF < 0.25	Any	0.7
0.25 ≤ PF < 0.50	Any	0.7
PF ≥ 0.50	Any	0.7
Skylights - U-Value (maximum)	X	0.8

Roof Assemblies: (either/or)	Insulation Between Framing	Continuous Insulation
All-Wood Joist/Truss	R-19	R-14
Non-wood Joist/Truss	R-19	R-15
Concrete Slab or Deck	NA	R-14
Metal Purlin with Thermal Break	R-25	R-15
Metal Purlin w/o Thermal Break	X	R-15

Floor Assemblies: (either/or)	Insulation Between Framing	Continuous Insulation
All-Wood Joist/Truss	R-19	R-16
Non-wood Joist/Truss	R-25	R-17
Concrete Slab or Deck	NA	R-17
Slab, Perimeter, and Below-Grade Wall	R-5	

* For masonry walls, average R-value shall be calculated based on the assumption of isothermal planes, using methodology in 1997 ASHRAE Fundamentals Handbook, Chapter 22.

TABLE 1304.2.6
BUILDING ENVELOPE REQUIREMENTS
Climate Zone 13a
Glazing Area Over 10% but not greater than 25% of Above Grade Wall Area

Above-Grade Walls:	Continuous Insulation (or average insulation value)*	Metal Framing (c.i. = continuous insulation)	Wood Framing
Framed or Masonry < 35 psf.	R-7	R-13 + R-3 c.i.	R-11
Masonry ≥ 35 psf.	R-5	R-11 + R-3 c.i.	R-11

Window Assemblies:	SHGC (maximum)	U-Value (maximum)
PF < 0.25	0.6	0.6
0.25 ≤ PF < 0.50	0.7	0.6
PF ≥ 0.50	Any	0.6
Skylights - U-Value (maximum)	X	0.8

Roof Assemblies: (either/or)	Insulation Between Framing	Continuous Insulation
All-Wood Joist/Truss	R-25	R-19
Non-wood Joist/Truss	R-25	R-20
Concrete Slab or Deck	NA	R-19
Metal Purlin with Thermal Break	R-30	R-20
Metal Purlin w/o Thermal Break	X	R-20

Floor Assemblies: (either/or)	Insulation Between Framing	Continuous Insulation
All-Wood Joist/Truss	R-19	R-16
Non-wood Joist/Truss	R-25	R-17
Concrete Slab or Deck	NA	R-17
Slab, Perimeter, and Below-Grade Wall	R-5	

TABLE 1304.2.7
BUILDING ENVELOPE REQUIREMENTS
Climate Zone 13a
Glazing Area Over 25% but not greater than 40% of Above Grade Wall Area

Above-Grade Walls:	Continuous Insulation (or average insulation value)*	Metal Framing (c.i. = continuous insulation)	Wood Framing
Framed or Masonry < 35 psf.	R-7	R-13 + R-3 c.i.	R-11
Masonry ≥ 35 psf.	R-5	R-11 + R-3 c.i.	R-11

Window Assemblies:	SHGC (maximum)	U-Value (maximum)
PF < 0.25	0.5	0.5
0.25 ≤ PF < 0.50	0.6	0.5
PF ≥ 0.50	0.7	0.5
Skylights - U-Value (maximum)	X	0.8

Roof Assemblies: (either/or)	Insulation Between Framing	Continuous Insulation
All-Wood Joist/Truss	R-30	R-23
Non-wood Joist/Truss	R-30	R-24
Concrete Slab or Deck	NA	R-23
Metal Purlin with Thermal Break	X	R-24
Metal Purlin w/o Thermal Break	X	R-24

Floor Assemblies: (either/or)	Insulation Between Framing	Continuous Insulation
All-Wood Joist/Truss	R-19	R-16
Non-wood Joist/Truss	R-25	R-17
Concrete Slab or Deck	NA	R-17
Slab, Perimeter, and Below-Grade Wall	R-5	

* For masonry walls, average R-value shall be calculated based on the assumption of isothermal planes, using methodology in 1997 ASHRAE Fundamentals Handbook, Chapter 22.

TABLE 1304.2.8
BUILDING ENVELOPE REQUIREMENTS
Climate Zone 13a
Glazing Area Over 40% but not greater than 50% of Above Grade Wall Area

Above-Grade Walls:	Continuous Insulation (or average insulation value)*	Metal Framing (c.i. = continuous insulation)	Wood Framing
Framed or Masonry < 35 psf.	R-7	R-13 + R-3 c.i.	R-11
Masonry ≥ 35 psf.	R-5	R-11 + R-3 c.i.	R-11

Window Assemblies:	SHGC (maximum)	U-Value (maximum)
PF < 0.25	0.4	0.4
0.25 ≤ PF < 0.50	0.5	0.4
PF ≥ 0.50	0.7	0.4
Skylights - U-Value (maximum)	X	0.8

Roof Assemblies: (either/or)	Insulation Between Framing	Continuous Insulation
All-Wood Joist/Truss	R-30	R-23
Non-wood Joist/Truss	R-30	R-24
Concrete Slab or Deck	NA	R-23
Metal Purlin with Thermal Break	R-30	R-24
Metal Purlin w/o Thermal Break	R-38	R-24

Floor Assemblies: (either/or)	Insulation Between Framing	Continuous Insulation
All-Wood Joist/Truss	R-19	R-16
Non-wood Joist/Truss	R-25	R-17
Concrete Slab or Deck	NA	R-17
Slab, Perimeter, and Below-Grade Wall	R-5	

TABLE 1304.2.9
BUILDING ENVELOPE REQUIREMENTS
Climate Zone 14a
Glazing Area 10% or less of Above Grade Wall Area

Above-Grade Walls:	Continuous Insulation (or average insulation value)*	Metal Framing (c.i. = continuous insulation)	Wood Framing
Framed or Masonry < 35 psf.	R-7	R-11 + R-3 c.i.	R-11
Masonry ≥ 35 psf.	R-5	R-11 + R-3 c.i.	R-11

Window Assemblies:	SHGC (maximum)	U-Value (maximum)
PF < 0.25	Any	0.7
0.25 ≤ PF < 0.50	Any	0.7
PF ≥ 0.50	Any	0.7
Skylights - U-Value (maximum)	X	0.8

Roof Assemblies: (either/or)	Insulation Between Framing	Continuous Insulation
All-Wood Joist/Truss	R-19	R-17
Non-wood Joist/Truss	R-25	R-18
Concrete Slab or Deck	NA	R-17
Metal Purlin with Thermal Break	R-30	R-18
Metal Purlin w/o Thermal Break	X	R-18

Floor Assemblies: (either/or)	Insulation Between Framing	Continuous Insulation
All-Wood Joist/Truss	R-25	R-18
Non-wood Joist/Truss	R-25	R-19
Concrete Slab or Deck	NA	R-19
Slab, Perimeter, and Below-Grade Wall	R-5	

* For masonry walls, average R-value shall be calculated based on the assumption of isothermal planes, using methodology in 1997 ASHRAE Fundamentals Handbook, Chapter 22.

TABLE 1304.2.10
BUILDING ENVELOPE REQUIREMENTS
Climate Zone 14a
Glazing Area Over 10% but not greater than 25% of Above Grade Wall Area

Above-Grade Walls:	Continuous Insulation (or average insulation value)*	Metal Framing (c.i. = continuous insulation)	Wood Framing
Framed or Masonry < 35 psf.	R-7	R-13 + R-3 c.i.	R-11
Masonry ≥ 35 psf.	R-5	R-11 + R-3 c.i.	R-11

Window Assemblies:	SHGC (maximum)	U-Value (maximum)
PF < 0.25	0.5	0.6
0.25 ≤ PF < 0.50	0.6	0.6
PF ≥ 0.50	0.7	0.6
Skylights - U-Value (maximum)	X	0.8

Roof Assemblies: (either/or)	Insulation Between Framing	Continuous Insulation
All-Wood Joist/Truss	R-25	R-19
Non-wood Joist/Truss	R-25	R-20
Concrete Slab or Deck	NA	R-19
Metal Purlin with Thermal Break	R-30	R-20
Metal Purlin w/o Thermal Break	X	R-20

Floor Assemblies: (either/or)	Insulation Between Framing	Continuous Insulation
All-Wood Joist/Truss	R-25	R-18
Non-wood Joist/Truss	R-25	R-19
Concrete Slab or Deck	NA	R-19
Slab, Perimeter, and Below-Grade Wall	R-5	

TABLE 1304.2.11
BUILDING ENVELOPE REQUIREMENTS
Climate Zone 14a
Glazing Area Over 25% but not greater than 40% of Above Grade Wall Area

Above-Grade Walls:	Continuous Insulation (or average insulation value)*	Metal Framing (c.i. = continuous insulation)	Wood Framing
Framed or Masonry < 35 psf.	R-7	R-13 + R-3 c.i.	R-11
Masonry ≥ 35 psf.	R-5	R-11 + R-3 c.i.	R-11

Window Assemblies:	SHGC (maximum)	U-Value (maximum)
PF < 0.25	0.4	0.5
0.25 ≤ PF < 0.50	0.5	0.5
PF ≥ 0.50	0.6	0.5
Skylights - U-Value (maximum)	X	0.8

Roof Assemblies: (either/or)	Insulation Between Framing	Continuous Insulation
All-Wood Joist/Truss	R-30	R-23
Non-wood Joist/Truss	R-30	R-24
Concrete Slab or Deck	NA	R-23
Metal Purlin with Thermal Break	X	R-24
Metal Purlin w/o Thermal Break	X	R-24

Floor Assemblies: (either/or)	Insulation Between Framing	Continuous Insulation
All-Wood Joist/Truss	R-25	R-18
Non-wood Joist/Truss	R-25	R-19
Concrete Slab or Deck	NA	R-19
Slab, Perimeter, and Below-Grade Wall	R-5	

* For masonry walls, average R-value shall be calculated based on the assumption of isothermal planes, using methodology in 1997 ASHRAE Fundamentals Handbook, Chapter 22.

TABLE 1304.2.12
BUILDING ENVELOPE REQUIREMENTS
Climate Zone 14a
Glazing Area Over 40% but not greater than 50% of Above Grade Wall Area

Above-Grade Walls:	Continuous Insulation (or average insulation value)*	Metal Framing (c.i. = continuous insulation)	Wood Framing
Framed or Masonry < 35 psf.	R-7	R-13 + R-3 c.i.	R-11
Masonry ≥ 35 psf.	R-5	R-11 + R-3 c.i.	R-11

Window Assemblies:	SHGC (maximum)	U-Value (maximum)
PF < 0.25	0.4	0.4
0.25 ≤ PF < 0.50	0.5	0.4
PF ≥ 0.50	0.6	0.4
Skylights - U-Value (maximum)	X	0.8

Roof Assemblies: (either/or)	Insulation Between Framing	Continuous Insulation
All-Wood Joist/Truss	R-30	R-23
Non-wood Joist/Truss	R-30	R-24
Concrete Slab or Deck	NA	R-23
Metal Purlin with Thermal Break	R-38	R-24
Metal Purlin w/o Thermal Break	R-38	R-24

Floor Assemblies: (either/or)	Insulation Between Framing	Continuous Insulation
All-Wood Joist/Truss	R-25	R-18
Non-wood Joist/Truss	R-25	R-19
Concrete Slab or Deck	NA	R-19
Slab, Perimeter, and Below-Grade Wall	R-5	

* For masonry walls, average R-value shall be calculated based on the assumption of isothermal planes, using methodology in 1997 ASHRAE Fundamentals Handbook, Chapter 22.

1304.3 Air Leakage

1304.3.1 Air Barriers: The building envelope shall be designed and constructed with a continuous air barrier to control air leakage into, or out of the conditioned space. An air barrier shall also be provided for interior partitions between conditioned space and space designed to maintain temperature or humidity levels which differ from those in the conditioned space by more than 50% of the difference between the conditioned space and design ambient conditions. The air barrier shall have the following characteristics:

1. It must be continuous, with all joints made air-tight.
2. It shall have an air permeability not to exceed 0.004 cfm/ft^2 under a pressure differential of 0.3 in. water (1.57 psf.) (equal to 0.02L/s/m^2 @ 75 Pa.) .
3. It shall be capable of withstanding positive and negative combined design wind, fan and stack pressures on the envelope without damage or displacement, and shall transfer the load to the structure. It shall not displace adjacent materials under full load.
4. It shall be durable or maintainable.
5. The air barrier shall be joined in an air-tight and flexible manner to the air barrier material of adjacent systems, allowing for the relative movement of systems due to thermal and moisture variations and creep. Connection shall be made between:
   a. Foundation and walls.
   b. Walls and windows or doors.
   c. Different wall systems.
   d. Wall and roof.
   e. Wall and roof over unconditioned space.
   f. Walls, floor and roof across construction, control and expansion joints.
   g. Walls, floors and roof to utility, pipe and duct penetrations.

1304.3.2 Air Barrier Penetrations: All penetrations of the air barrier and paths of air infiltration/exfiltration shall be made air-tight.

1304.3.3 Fenestration and Doors: Air leakage for *fenestration* and *doors* shall be determined in accordance with NFRC 400 or ASTM E 283 @ 1.57 psf (75 Pa.). Air leakage shall be determined by an independent laboratory accredited by a nationally recognized accreditation organization and shall be certified by the manufacturer. Air leakage shall not exceed 1.0 cfm/ft^2 for glazed swinging entrance doors and for revolving doors, and 0.4 cfm/ft^2 for all other products under a pressure differential of 0.3 inches of water (1.57 psf.)

Exceptions:

1. Field fabricated *fenestration* and *doors* that are weather-stripped.
2. For garage *doors*, air leakage determined by test at standard test conditions in accordance with NAGDM 105 shall be an acceptable alternate for compliance with air leakage requirements.

1304.3.4 Shaft, Chute, Access Opening, Stairwell and Elevator Lobby Doors: Doors and access openings leading to shafts, chutes, stairwells, and elevator lobbies shall either meet the requirements of 780 CMR 1304.3.3 or shall be equipped with weatherseals.

Exception: Weatherseals on elevator lobby doors are not required when a smoke control system is installed in accordance with 780 CMR 921.7.

1304.3.5 Loading Dock Weatherseals: Cargo *doors* and loading dock *doors* shall be equipped with weatherseals to restrict *infiltration* when vehicles are parked in the doorway.

1304.3.6 Vestibules: A *door* that separates *conditioned space* from the exterior shall be protected with an enclosed vestibule, with all *doors* opening into and out of the vestibule equipped with self-closing devices. Vestibules shall be designed so that in passing through the vestibule it is not necessary for the interior and exterior *doors* to open at the same time. Interior and exterior *doors* shall have a minimum distance between them of not less than seven ft (2.1 m) when in the closed position.

Exceptions:

1. *doors* not intended to be used as a *building entrance door*, such as doors for mechanical or electrical equipment rooms;
2. *doors* opening directly from a *dwelling unit*;
3. *doors* that open directly from a space less than 3000 ft^2 in area;
4. revolving *doors* or *doors* adjacent to revolving *doors*;
5. *doors* used primarily to facilitate vehicular movement or material handling and adjacent personnel *doors*.

1304.3.7 Air-tight Dampers: Air-tight operable dampers shall be installed where the air barrier is penetrated by:

1. fixed open louvers such as in elevator shafts and machine rooms;
2. mechanical system components which allow infiltration or exfiltration of air when the systems are inactive, such as atrium smoke exhaust systems and make-up air louvers;
3. outside air intakes, exhaust outlets, relief outlets, stair shaft, elevator shaft smoke relief openings, and other similar elements.

Such dampers shall have a leakage no greater than 3cfm/ft^2 at 1.0 in w.g. when tested in accordance with AMCA Standard 500. They shall be set in the closed position, and shall automatically open upon:

1. the activation of any fire alarm initiating device of the building's fire alarm system;
2. the interruption of power to the damper.

1304.3.8 Recessed Lighting Fixtures: When installed in the building envelope, recessed lighting fixtures shall meet one of the following requirements:

1. Type IC rated, manufactured with no penetrations between the inside of the recessed fixture and ceiling cavity and sealed or gasketed to prevent air leakage into the unconditioned space.
2. Type IC rated, in accordance with ASTM E 283 no more than 2.0 cfm air movement from the conditioned space to the ceiling cavity. The lighting fixture shall be tested at 75 Pa or 1.57 lbs./ft.^{2} pressure difference and shall be labeled.

1304.3.9 Envelope Gaps and Cavities: All gaps and cavities between rough framing and door and window heads, jambs, and sills shall be made air-tight, filled with insulation and covered with a vapor barrier meeting the criteria for vapor barriers.

1304.4 Insulation General: Where insulation is required in 780 CMR 1304.2 or 780 CMR 1304.5, it shall also comply with 780 CMR 1304.4.1 through 1304.4.5.

1304.4.1 Insulation Installation: Insulation materials shall be installed in accordance with manufacturer's recommendations as to achieve and maintain *rated R-value of insulation*.

Where continuous wall insulation is required in 780 CMR 1304.2 or 780CMR 1304.5 in multi-story buildings, the insulation must be continuous across floor structures.

Open-blown or poured loose-fill insulation shall not be used in *attic roof* spaces with eave vents when the slope of the ceiling is more than three in 12 unless special provisions are made to prevent settling and maintain an air space for ventilation above the insulation. Baffling of the vent openings shall be provided to deflect the incoming air above the surface of the insulation.

1304.4.2 Substantial Contact: Insulation shall be installed in a permanent manner in *substantial contact* with adjacent surfaces in a manner which will prevent convection of air around the insulation. Flexible batt insulation installed in floor cavities shall be supported in a permanent manner by supports no greater than 24 in. on center.

Batt insulation with integral vapor barrier shall be attached to the winter warm sides or faces of wall studs, sole plates, top plates, lintels and headers at intervals of eight inches on center. Where batt/blanket insulation is of a "friction fit" design and a poly vapor barrier is employed, the vapor barrier shall be affixed to the interior face of the wall studs, sole plates, top plates, lintels and headers (winter warm side) in accordance with the insulation manufacturer's recommendations.

1304.4.3 Recessed Equipment: Lighting fixtures; heating, ventilating, and air-conditioning equipment, including wall heaters, ducts, and plenums; and other equipment shall not be recessed in such a manner to affect the insulation thickness unless:

1. the total combined area affected (including necessary clearances) is less than one percent of the opaque area of the assembly, or
2. the entire *roof*, *wall*, or *floor* is covered with insulation to the full depth required or
3. the effects of reduced insulation are included in calculations using an area weighted average method and compressed insulation values from the ASHRAE 1997 Handbook of Fundamentals. In all cases, air leakage through the recessed equipment to the *conditioned space* shall be prevented.

1304.4.4 Location of Roof Insulation: The *roof* shall be insulated in a location other than directly on a suspended ceiling with removable ceiling panels.

1304.4.5 Insulation Protection: Exterior insulation shall be covered with a protective material to prevent damage from sunlight, moisture, landscaping operations, equipment maintenance, and wind. In *attics* and mechanical rooms, a way to access equipment that prevents damaging or compressing the insulation shall be provided. Foundation vents shall not interfere with the insulation.

Insulation materials in ground contact shall have water absorption no greater than 0.3% when tested in accordance with ASTM C272.

Exception: Insulation materials that have a water drainage system included.

1304.5 Building Envelope Trade-Off Option: The *building envelope* complies with the standard if the proposed building satisfies the provisions of 780 CMR 1304.1, 780 CMR 1304.3, and 780 CMR 1304.4, and the *envelope performance factor* of the proposed building is less than or equal to the *envelope performance factor* of the budget building. The *envelope performance factor* considers only the *building envelope* components. Schedules of operation, lighting power, equipment power, occupant density, and mechanical systems shall be the same for both the proposed building and the budget building. *Envelope performance factor* shall be calculated using computer programs accepted by the Board of Building Regulations and Standards.

780 CMR 1305.0 HEATING VENTILATION AND AIR CONDITIONING

1305.1 General: 780 CMR 1305.0 covers the design and construction of mechanical systems and equipment serving the building heating, cooling, or ventilating needs.

1305.1.1 Compliance: Compliance with 780 CMR 1305.0 shall be achieved by meeting either 780 CMR 1305.2 or 780 CMR 1305.3.

1305.2 Simple HVAC Systems and Equipment:

1305.2.1 Scope: 780 CMR 1305.2 applies to buildings served by unitary or packaged air conditioners or heat pumps, packaged terminal air conditioners, and packaged furnaces each serving one zone and controlled by a single thermostatic control in the zone served. It also applies to buildings served by packaged boilers and two-pipe heating systems serving one or more zones.

780 CMR 1305.2 does not apply to non-unitary or non-packaged HVAC equipment and systems or to chiller systems.

780 CMR 1305.2 does not apply to buildings in which the outside air quantity capable of being supplied by any individual fan system exceeds 3000 cfm or 70% of the total design supply air quantity for the fan system.

1305.2.2 Calculation of Heating and Cooling Loads: Design loads shall be determined in accordance with the procedures described in Chapters 25 and 26 of the ASHRAE 1997 Handbook of Fundamentals or an approved equivalent computation procedure.

1305.2.2.1 Equipment and System Sizing: Heating and cooling equipment and systems capacity shall not exceed the loads calculated in accordance with 780 CMR 1305.2.2. A single piece of equipment providing both heating and cooling shall satisfy this provision for one function with the capacity for the other function as small as possible, within available equipment options.

1305.2.3 HVAC Equipment Performance Requirements: Packaged air conditioners and heat pumps with capacity greater than 240,000 Btu/h, ground-source and ground water source heat pumps, and duct furnaces and unit heaters shall meet the minimum efficiency requirements of Tables 1305.3.3a, b, and d, when tested and rated in accordance with the referenced test procedure. The efficiency shall be verified through data furnished by the manufacturer or through certification under an approved certification program. Where multiple rating conditions and/or performance requirements are provided, the equipment shall satisfy all stated requirements.

Other new equipment within the scope of 780 CMR 1305.2 is required to meet efficiency standards administered by the federal government. The efficiency of used equipment within the scope of the federal standards shall be verified through data furnished by the manufacturer.

Equipment not required to meet efficiency standards administered by the federal government, and not in Tables 1305.3.3a, b, and d may be used, and have no minimum performance requirements.

1305.2.4 Temperature and Humidity Controls:

1305.2.4.1 Temperature Controls: Each heating and cooling system shall have at least one programmable thermostat. The thermostat shall have the capability to setback or shut-down the system based on day of the week and time of day and a readily accessible manual override that will return to the pre-setback or shutdown schedule without reprogramming. Thermostatic controls shall be capable of providing a temperature range or dead band of at least 5°F within which the supply of heating and cooling energy to the zone is shut off or reduced to a minimum.

Exception: Thermostats requiring manual changeover between heating and cooling modes.

Where heating and cooling to a zone are controlled by separate zone thermostatic controls located within the zone, means (such as limit switches, mechanical stops, or, for *direct digital control* (DDC) systems, software programming) shall be provided to prevent the heating set point from exceeding the cooling set point minus any applicable proportional band.

Heat pumps having supplementary electric resistance heat shall have controls that, except during defrost, prevent supplemental heat operation when the heat pump can meet the heating load.

1305.2.4.2 Humidity Controls: When humidistats are installed they shall prevent the use of fossil fuel or electric power to achieve a humidity below 60% when the system controlled is cooling, and above 30% when the system controlled is heating.

1305.2.5 Hydronic System Controls: Hydronic heating systems of at least 300,000 Btu/h design capacity supplying heated water to comfort conditioning systems shall include controls that have the capability to automatically reset the supply water temperatures by representative building loads (including return water temperature) or by outside air temperature.

Exception: systems which vary water flow in compliance with 780 CMR 1305.3.5.4.

Hydronic heating systems comprised of multiple packaged boilers and designed to deliver conditioned water or steam into a common distribution system shall include automatic controls capable of sequencing operation of the boilers.

Hydronic heating systems comprised of a single boiler of greater than 500,000 Btu/h design capacity shall include either a multi-staged or modulating burner.

1305.2.6 Ventilation: Natural or mechanical ventilation shall be provided in accordance with the mechanical code listed in *Appendix A*. Any mechanical ventilation system shall have the capability to reduce the outdoor air supply to the minimum required by the mechanical code listed in *Appendix A*.

1305.2.6.1 Distributed Fan Systems: Where mechanical ventilation is provided by multiple fan systems located in a plenum or other enclosed space, outdoor air shall be ducted directly to each individual fan system.

1305.2.6.2 Shutoff Dampers: Outdoor air supply ducts and exhaust ducts associated with the mechanical ventilation system shall be provided with automatic means to reduce and shutoff air flow.

Exception:

1. Systems serving areas designed for continuous operation .
2. Individual systems with an outside air intake or exhaust capacity of 300 cfm or less.
3. Systems with readily accessible manual dampers.

1305.2.7 Economizers: Each system over 65,000 Btu/h cooling capacity shall have an economizer that will automatically shut off the cooling system and allow 100% of the supply air to be outdoor air.

1305.2.8 Duct and Plenum Insulation and Sealing: All supply and return air ducts and plenums shall be insulated with a minimum of R-5 insulation when located in *unconditioned spaces* and with a minimum of R-8 insulation when located outside the building envelope. When located within a building envelope assembly the duct or plenum shall be separated from the building exterior or unconditioned or exempt spaces by a minimum R-5 insulation. Required R-values are the "labeled" R-values for such ducts.

Exception:

1. When located within equipment.

2. When the design temperature difference between the interior and exterior of the duct or plenum does not exceed 15°F.
3. Exhaust air ducts.
4. Outside air supply ducts located outside of the building envelope.

All joints, longitudinal and transverse seams, and connections in duct work, shall be securely fastened and sealed with welds, gaskets, mastics (adhesives), mastic-plus-embedded-fabric systems, or tapes. Tapes and mastics used with rigid fibrous glass ducts shall be listed and labeled in accordance with UL 181A. Tapes and mastics used with flexible air ducts shall be listed and labeled in accordance with UL 181B. Duct tape is not permitted as a sealant on any metal ducts.

1305.2.9 Piping Insulation: All low pressure side refrigerant piping shall be insulated with ¾ in. of insulation, hot water piping for comfort conditioning shall be insulated with one in. of insulation, and steam system piping shall be insulated with two in. of insulation. All insulation shall have a conductivity not exceeding 0.27 Btu-in./hr-ft^2 °F.

1305.3 Complex HVAC Systems and Equipment:

1305.3.1 Scope: This section applies to all HVAC systems and equipment other than those covered in 780 CMR 1305.2.

1305.3.2 Calculation of Heating and Cooling Loads: Design loads shall be determined in accordance with the procedures described in Chapters 25 and 26 of the ASHRAE 1997 Handbook of Fundamentals or an approved equivalent computation procedure.

1305.3.2.1 Equipment and System Sizing: Heating and cooling equipment and system capacity shall not exceed the loads calculated in accordance with 780 CMR 1305.3.2.

1305.3.3 HVAC Equipment Performance Requirements: Equipment shall be newly purchased or shall meet the minimum efficiency requirements of Tables 1305.3.3a. through f., when tested and rated in accordance with the referenced test procedure. The efficiency shall be verified through data furnished by the manufacturer or through an approved certification program. Where multiple rating conditions and/or performance requirements are provided, the equipment shall satisfy all stated requirements.

Other new equipment within the scope of 780 CMR 1305.3.3 is required to meet efficiency standards administered by the federal government. The efficiency of used equipment within the scope of the federal standards shall be verified through data furnished by the manufacturer.

Equipment not required to meet efficiency standards administered by the federal government, and not in Tables 1305.3.3a. through f. may be used, and have no minimum performance requirements.

1305.3.3.1 Duct Furnaces and Unit Heaters: Warm air duct furnaces and unit heaters shall have an intermittent ignition device, maximum jacket losses of 0.75% of the equipment input rating, and power venting or a flue damper. When combustion air is drawn from the conditioned space a vent damper shall be permitted to be used in lieu of the required flue damper.

Table 1305.3.3a
Unitary Air Conditioners and Condensing Units, Electrically Operated, Minimum Efficiency Requirements

Equipment Type	Size Category	Sub-Category or Rating Condition	Minimum Efficiency[a]	Test Procedure
Air Conditioners, Air Cooled	> 240,000 Btu/h and ≤ 760,000 Btu/h	Split System and Single Package	9.5 EER[b] 9.7 IPLV[b]	ARI 210/240
	> 760,000 Btu/h	Split System and Single Package	9.2 EER[b] 9.4 IPLV[b]	
Air Conditioners, Water and Evaporatively Cooled	> 240,000 Btu/h	Split System and Single Package	11.0 EER[b] 10.3 IPLV[b]	ARI 340/360
Condensing Units, Air Cooled	≥ 135,000 Btu/h		10.1 EER 11.2 IPLV	ARI 365
Condensing Units, Water or Evaporatively Cooled	≥ 135,000 Btu/h		13.1 EER 13.1 IPLV	

[a] IPLVs are only applicable to equipment with capacity modulation.

[b] Deduct 0.2 from the required EERs and IPLVs for units with a supplemental heating section other than electric resistance.

Table 1305.3.3b
Unitary and Applied Heat Pumps, Electrically Operated, Minimum Efficiency Requirements

Equipment Type	Size Category	Sub-Category or Rating Condition	Minimum Efficiency[a]	Test Procedure
Air Cooled, (Cooling Mode)	> 240,000 Btu/h	Split System and Single Package	9.0 EER[b] 9.2 IPLV[b]	ARI 340/360
Air Cooled, (Heating Mode)	> 240,000 Btu/h	47°F db/43°F wb outdoor 17°F db/10°F wb outdoor	3.1 COP 2.0 COP	ARI 340/360
Groundwater- Source (Cooling Mode)	< 135,000 Btu/h	70°F Entering Water 50°F Entering Water	13.5 EER 15.0 EER	ISO 13256-1
Ground Source (Cooling Mode)	< 135,000 Btu/h	77°F Entering Brine 70°F Entering Brine	12.4 EER 12.8 EER	ISO 13256-1
Groundwater- Source (Heating Mode)	< 135,000 Btu/h (Cooling Capacity)	70°F Entering Water 50°F Entering Water	3.9 COP 3.4 COP	ISO 13256-1
Ground Source (Heating Mode)	< 135,000 Btu/h (Cooling Capacity)	32°F Entering Brine 41°F Entering Brine	2.8 COP 3.0 COP	ISO 13256-1

[a] IPLVs are only applicable to equipment with capacity modulation.

[b] Deduct 0.2 from the required EERs and IPLVs for units with supplemental heating sections other than electric resistance heat.

Table 1305.3.3c
Water Chilling Packages, Minimum Efficiency Requirements

Equipment Type	Size Category	Minimum Efficiency[a]	Test Procedure
Air Cooled, With Condenser, Electrically Operated	All Capacities	2.80 COP 2.80 IPLV	ARI 550 or ARI 590 as appropriate
Air Cooled, Without Condenser, Electrically Operated	All Capacities	3.10 COP 3.10 IPLV	
Water Cooled, Electrically Operated, Positive Displacement (Reciprocating)	All Capacities	4.20 COP 4.65 IPLV	ARI 590
Water Cooled, Electrically Operated, Positive Displacement (Rotary Screw and Scroll)	< 150 Tons	4.45 COP 4.50 IPLV	ARI 550 or ARI 590 as appropriate
	≥ 150 Tons and < 300 Tons	4.90 COP 4.95 IPLV	
	≥ 300 Tons	5.50 COP 5.60 IPLV	
Water Cooled, Electrically Operated, Centrifugal	< 150 Tons	5.00 COP 5.00 IPLV	ARI 550
	≥ 150 Tons and < 300 Tons	5.55 COP 5.55 IPLV	
	≥ 300 Tons	6.10 COP 6.10 IPLV	
Air Cooled Absorption Single Effect	All Capacities	0.60 COP	ARI 560
Water Cooled Absorption Single Effect	All Capacities	0.70 COP	
Absorption Double Effect, Indirect-Fired	All Capacities	1.00 COP 1.05 IPLV	
Absorption Double Effect, Direct-Fired	All Capacities	1.00 COP 1.00 IPLV	

[a] The chiller equipment requirements do not apply for chillers used in low temperature applications where the design leaving fluid temperature is less than or equal to 35° F.

Table 1305.3.3d
Warm Air Duct Furnaces and Unit Heaters, Minimum Efficiency Requirements

Equipment Type	Size Category (Input)	Sub-Category or Rating Condition[a]	Minimum Efficiency[d]	Minimum Efficiency[c]	Test Procedure
Warm Air Duct Furnaces, Gas-Fired	All Capacities	Maximum Capacity Minimum Capacity	78% E_t 75% E_t	80% E_c ----	ANSI Z83.9
Warm Air Unit Heaters, Gas-Fired	All Capacities	Maximum Capacity Minimum Capacity	78% E_t 74% E_t	80% E_c ____	ANSI Z83.8
Warm Air Unit Heaters, Oil-Fired	All Capacities	Maximum Capacity Minimum Capacity	81% E_t 81% E_t	80% E_c ____	UL 731

[a] Minimum and maximum ratings as provided for and allowed by the unit's controls.

[c] E_c = Combustion efficiency (100% less flue losses). See test procedure for detailed discussion.

[d] E_t = Thermal efficiency. See test procedure for detailed discussion.

Table 1305.3.3e
Performance Requirements for Heat Rejection Equipment

Equipment Type	Total System Heat Rejection Capacity at Rated Conditions	Sub-Category or Rating Condition	Performance Required	Test Procedure[c]
Propeller or Axial Fan Cooling Towers	All	95 °F Entering Water 85°F Leaving Water 75°F wb Outdoor Air	≥ 38.2 gpm/hp[a]	CTI ATC-105
Centrifugal Fan Cooling Towers	All	95 °F Entering Water 85°F Leaving Water 75°F wb Outdoor Air	≥ 20.0 gpm/hp[a]	CTI ATC-105
Air Cooled Condensers	All	125 °F Condensing Temperature R22 Test Fluid 190°F Entering Gas T emperature 15°F Subcooling 95°F Entering Drybulb	≥ 176,000 Btu/h*hp[b]	ARI 460

[a] Maximum flow (gpm)/rated motor power (hp)

[b] Heat rejected from the refrigerant (Btu/h)/rated motor power (hp).

Table 1305.3.3f
Boilers, Gas- and Oil-Fired, Minimum Efficiency Requirements

Equipment Type	Size Category	Sub-Category or Rating Condition	Minimum Efficiency[b]	Efficiency as of 1/1/2001[c]	Test Procedure
Boilers, Gas-Fired	≥ 300,000 Btu/h and ≥ 2,500,000 Btu/h	Maximum Capacity[a] Minimum Capacity[a]	80% E_c 80% E_c	75% E_t	H.I. Htg Boiler Std 86[d]
	> 2,500,000 Btu/h	Hot Water	80% E_c	80% E_c	
	> 2,500,000 Btu/h	Steam	80% E_c	80% E_c	
Boilers, Oil-Fired	≥ 300,000 Btu/h and ≥ 2,500,000 Btu/h	Maximum Capacity[a] Minimum Capacity[a]	83% E_c 83% E_c	78% E_t ____	H.I. Htg Boiler Std 86[d]
	> 2,500,000 Btu/h	Hot Water	83% E_c	83% E_c	
	> 2,500,000 Btu/h	Steam	83% E_c	83% E_c	
Oil-Fired (Residual)	≥ 300,000 Btu/h and ≥ 2,500,000 Btu/h	Maximum Capacity[a] Minimum Capacity[a]	83% E_c 83% E_c	78% E_t ____	H.I. Htg Boiler Std 86[d]
	> 2,500,000 Btu/h	Hot Water	83% E_c	83% E_c	
	> 2,500,000 Btu/h	Steam	83% E_c	83% E_c	

[a] Minimum and maximum ratings as provided for and allowed by the unit's controls.

[b] E_c = Combustion efficiency (100% less flue losses). See reference document for detailed information.

[c] E_t = Thermal efficiency. See reference document for detailed information.

[d] Alternate test procedures used at the manufacturer's option are ASME PTC-4.1 for units over 5,000,000 Btu/h input, or ANSI Z21.13 for units greater than or equal to 300,000 Btu/h and less than or equal to 2,500,000 Btu/h input.

1305.3.4 Temperature and Humidity Controls

1305.3.4.1 Thermostatic Controls: The supply of heating and cooling energy to each zone shall be individually controlled by thermostatic controls capable of responding to temperature within the zone.

Exception: Independent perimeter systems that are designed to offset only building envelope heat losses and/or gains serving one or more zones also served by an interior system provided:

1. the perimeter system includes at least one thermostatic control zone for each building exposure of the building (face within ± 45°) having exterior walls facing only one orientation for more than 50 contiguous feet and,
2. the perimeter system heating and cooling supply is controlled by thermostatic controls located within the zone(s) served by the system.

1305.3.4.2 Zone Thermostatic Control Capabilities:

1305.3.4.2.1 Set point Overlap Restriction: Where used to control both heating and cooling, zone thermostatic controls shall be capable of providing a temperature range or dead band of at least 5°F within which the supply of heating and cooling energy to the zone is shut off or reduced to a minimum.

Exception: Thermostats requiring manual changeover between heating and cooling modes.

Where heating and cooling to a zone are controlled by separate zone thermostatic controls located within the zone, means (such as limit switches, mechanical stops, or, for *direct digital control* (DDC) systems, software programming) shall be provided to prevent the heating set point from exceeding the cooling set point minus any applicable proportional band.

1305.3.4.2.2 Off-hour Controls: HVAC systems shall have setback and automatic controls.

Exception:

1. Systems that serve areas that operate continuously, or
2. Systems with full load demands not exceeding 2 kW when having a readily accessible manual shut off switch.

Thermostatic setback controls shall have the capability to setback or temporarily operate the system to maintain zone temperatures down to 55 °F or up to 85 °F.

HVAC systems shall be equipped with an automatic timeclock or programmable control that is capable of starting and stopping the system for seven different daily schedules per week, retaining programming and time setting during loss of power for a period of at least ten hours, and has a manual override that allows temporary operation of the system for up to two hours; a manually-operated timer capable of being adjusted to operate the system for up to two hours; or an occupancy sensor.

1305.3.4.3 Zone Isolation: Systems that serve zones that will have the capability to operate non- simultaneously shall include isolation devices and controls to shut off or set back the supply of ventilation air, heating, and cooling to each zone independently. For offices, each isolation area shall be no larger than 25,000 ft^2 of conditioned floor area nor include more than one floor. For all other occupancies, isolation areas shall be no larger than a single *zone*, a single tenant space, or 5000 ft^2 of conditioned floor area, whichever is larger.

Exception: exhaust air and outside air connections to fan systems of 5,000 cfm and smaller.

1305.3.4.4 Humidifier Preheat: Humidifiers with preheating jackets mounted in the air stream shall be provided with an automatic valve to shut off preheat when humidification is not required.

1305.3.4.5 Humidification and Dehumidification: Where a *zone* is served by a system or systems with both humidification and dehumidification capability, means (such as limit switches, mechanical stops, or, for *direct digital control* (DDC) systems, software programming) shall be capable of preventing simultaneous operation of humidification and dehumidification equipment.

Exception:

1. Zones served by desiccant systems, used with direct evaporative cooling in series.
2. Systems serving zones where specific humidity levels are required, such as computer rooms, museums, and hospitals.

1305.3.4.6 Simultaneous Heating and Cooling: Zone thermostatic and humidistatic controls shall be capable of operating in sequence the supply of heating and cooling energy to the zone. Controls shall be capable of preventing reheating; recooling; mixing, or simultaneously supplying air that has been previously mechanically heated and air that has been previously cooled either by economizer operation or mechanical cooling.

Exception:

1. Variable air volume systems which, during periods of occupancy, are designed to reduce the primary air supply to each zone to a minimum before reheating, recooling, or mixing takes place.
2. Zones where special pressurization relationships or cross-contamination requirements are such that variable air volume systems are impractical.
3. At least 75% of the energy for reheating or for providing warm air in mixing systems is provided from a site-recovered or site-solar energy source.
4. Zones where special humidity levels are required to satisfy process needs.
5. Zones with a peak supply air quantity of 300 cfm or less and where the flow rate is less than 10% of the total fan system flow rate.
6. Zones where the volume of air to be reheated, recooled, or mixed is no greater than the volume of outside air required to meet the minimum ventilation requirements of 780 CMR 1305.3.6.

1305.3.4.7 Temperature Reset for Air Systems: Air systems supplying heated or cooled air to multiple zones shall include controls that have the capability to automatically reset the supply air in response to measured parameters representative of building loads or by outside air temperature. Temperature shall be capable of being reset by at least 25% of the design supply air to room air temperature difference.

Exception: Systems that comply with 780 CMR 1305.3.4.6 without using Exceptions 1, 2 or 6.

1305.3.5 Hydronic System Controls: The heating of fluids that have been previously mechanically cooled and the cooling of fluids that have been previously mechanically heated shall be limited in accordance with 780 CMR 1305.3.5.1 through 1305.3.5.3.

Hydronic heating systems comprised of multiple packaged boilers and designed to deliver conditioned water or steam into a common distribution system shall include automatic controls capable of sequencing operation of the boilers.

Hydronic heating systems comprised of a single boiler and greater than 500,000 Btu/h design capacity shall include either a multi-staged or modulating burner.

1305.3.5.1 Three-pipe System: Hydronic systems that use a common return system for both hot water and chilled water are prohibited.

1305.3.5.2 Two-pipe Changeover System: Systems that use a common distribution system to supply both heated and chilled water shall: be designed to allow a dead band between changeover from one mode to the other of at least 15°F outside air temperature; be designed to and provided with controls that will allow operation in one mode for at least 4 hours before changing over to the other mode; and be provided with controls that allow heating and cooling supply temperatures at the changeover point to be no more than 30°F apart.

1305.3.5.3 Hydronic (Water Loop) Heat Pump Systems: Hydronic heat pumps connected to a common heat pump water loop with central devices for heat rejection and heat addition shall have controls that are capable of providing a heat pump water supply temperature dead band of at least 20°F between initiation of heat rejection and heat addition by the central devices. If a closed-circuit cooling tower is used, either an automatic valve shall be installed to bypass all but a minimal flow of water around the tower, or low leakage positive closure dampers shall be provided. If an open-circuit cooling tower is used directly in the heat pump loop, an automatic valve shall be installed to bypass all heat pump water flow around the tower. If an open-circuit cooling tower is used in conjunction with a separate heat exchanger to isolate the cooling tower from the heat pump loop, then heat loss shall be controlled by shutting down the circulation pump on the cooling tower loop. Each hydronic heat pump on the hydronic system having a total pump system power exceeding ten hp shall have a two-position valve.

Exception: Where a system loop temperature optimization controller is installed and can determine the most efficient operating temperature based on real time conditions of demand and capacity, dead bands of less than 20°F shall be permitted.

1305.3.5.4 Hydronic Variable Flow Systems: HVAC pumping systems that include control valves designed to modulate or step open and closed as a function of load shall be designed for variable fluid flow and be capable of reducing pump flow rates to 50% or less of the design flow rate.

1305.3.5.5Maximum Power Use: Individual pumps serving variable flow systems having pump motors greater than 50 hp shall include controls that are capable of limiting pump motor demand to no more than 30% of design power input at 50% of design water flow.

1305.3.6 Ventilation: Ventilation, either natural or mechanical, shall be provided in accordance with the mechanical code listed in *Appendix A*. Where mechanical ventilation is provided the system shall provide the capability to reduce the outdoor air supply to the minimum required by the mechanical code listed in *Appendix A*.

1305.3.6.1 System Controls: Mechanical ventilation systems shall be provided with manual or automatic controls that will allow the fan system to operate whenever the spaces served are occupied. Air conditioning systems that supply required ventilation air shall be provided with controls designed to automatically maintain the required outdoor air supply rate during occupancy.

1305.3.6.2 Ventilation Controls for High-Occupancy Areas: Systems with design outside air capacities greater than 3000 cfm serving areas having an average design occupancy density exceeding 100 people per 1000 ft^2 shall include means to automatically reduce outside air intake below design rates when spaces are partially occupied. Ventilation controls shall be in compliance with the mechanical code listed in *Appendix A*.

Exception: fan systems with energy recovery.

1305.3.6.3 Distributed Fan Systems: Where mechanical ventilation is provided by multiple fan systems located in a plenum or other enclosed space, outdoor air shall be ducted directly to each individual fan system.

1305.3.6.4 Outdoor Air Intake Control: Variable air volume systems shall have controls that are capable of maintaining total system outdoor airflow at not less than 90% of the outdoor air supply rates required by 780 CMR 1305.3.6.

1305.3.6.5 Zone Minimum Air Flow: Variable air volume zone controls shall maintain the hourly average outdoor supply air rate at not less than the minimum supply rate required by 780 CMR 1305.3.6 under any thermal load condition expected to occur when the spaces served are occupied.

1305.3.6.6 Shutoff Damper Controls: Both outdoor air supply and exhaust ducts associated with the mechanical ventilation system shall be equipped with motorized dampers that will automatically shut when the systems or spaces served are not in use.

Exception:

1. Gravity (non-motorized) dampers installed in buildings less than three stories in height above grade.
2. Individual supply systems with an outside air intake or exhaust capacity of 300 cfm or less.

1305.3.7 Economizers: Each cooling system including the fan with a total cooling capacity of at least 65,000 Btu/h shall have an air or water economizer.

Cooling fan systems with a total cooling capacity less than 65,000 Btu/hr shall have an air or water economizer in buildings three stories and taller where the total cooling capacity of all such systems exceeds 2,400,000 Btu/h or 10% of the total installed cooling capacity, whichever is larger.

Exception:

1. Systems that include gas phase air cleaning in order to meet ventilation requirements.
2. Where more than 25% of the air designed to be supplied by the system is to spaces that are designed to be humidified above 35°F (2°C) dewpoint temperature in order to satisfy process needs.
3. Systems that include a condenser heat recovery system complying with 780 CMR 1305.3.12.
4. Systems that serve residential spaces where the system capacity is less than 325,000 cfm.
5. Systems that serve spaces whose sensible cooling load at design conditions, excluding transmission and infiltration loads, is less than or equal to transmission and infiltration losses at an outdoor temperature of 60°F.
6. Systems expected to operate less than 20 hours per week.
7. Where the use of outdoor air for cooling will affect supermarket open refrigerated casework systems.

1305.3.7.1 Air Economizers: Air economizers shall be designed to modulate outside air and return air dampers to provide up to the design supply air quantity as outside air.

Economizer dampers shall be capable of being sequenced with the mechanical cooling equipment and shall be controlled by other than mixed air temperature alone. The use of mixed air temperature limit control shall be permitted for systems controlled from space temperature (such as single-*zone* systems).

Air economizers shall be designed to automatically reduce the minimum supply of outside air to the minimum quantities required by 780 CMR 1305.3.6 when the use of outside air will no longer reduce cooling energy usage. Means shall be provided to relieve or exhaust excess return air during air economizer operation. The relief air outlet shall be located to avoid reintroduction of exhaust air into the building.

Controls shall be permitted to be installed to reduce the quantity of outdoor air to prevent coil frosting at the lowest stage of compressor unloading.

Exception:

1. Variable air volume systems which, during periods of occupancy, are designed to reduce the primary air supply to each zone to a minimum before reheating, recooling, or mixing takes place.
2. Zones where special pressurization relationships or cross-contamination requirements are such that variable air volume systems are impractical.
3. At least 75% of the energy for reheating or for providing warm air in mixing systems is provided from a site-recovered or site-solar energy source.
4. Zones where special humidity levels are required to satisfy process needs.
5. Zones with a peak supply air quantity of 300 cfm or less and where the flow rate is less than 10% of the total fan system flow rate.
6. Zones where the volume of air to be reheated, recooled, or mixed is no greater than the volume of outside air required to meet the minimum ventilation requirements of 780 CMR 1305.3.6.

1305.3.4.7 Temperature Reset for Air Systems: Air systems supplying heated or cooled air to multiple zones shall include controls that have the capability to automatically reset the supply air in response to measured parameters representative of building loads or by outside air temperature. Temperature shall be capable of being reset by at least 25% of the design supply air to room air temperature difference.

Exception: Systems that comply with 780 CMR 1305.3.4.6 without using Exceptions 1, 2 or 6.

1305.3.5 Hydronic System Controls: The heating of fluids that have been previously mechanically cooled and the cooling of fluids that have been previously mechanically heated shall be limited in accordance with 780 CMR 1305.3.5.1 through 1305.3.5.3.

Hydronic heating systems comprised of multiple packaged boilers and designed to deliver conditioned water or steam into a common distribution system shall include automatic controls capable of sequencing operation of the boilers.

Hydronic heating systems comprised of a single boiler and greater than 500,000 Btu/h design capacity shall include either a multi-staged or modulating burner.

1305.3.5.1 Three-pipe System: Hydronic systems that use a common return system for both hot water and chilled water are prohibited.

1305.3.5.2 Two-pipe Changeover System: Systems that use a common distribution system to supply both heated and chilled water shall: be designed to allow a dead band between changeover from one mode to the other of at least 15°F outside air temperature; be designed to and provided with controls that will allow operation in one mode for at least 4 hours before changing over to the other mode; and be provided with controls that allow heating and cooling supply temperatures at the changeover point to be no more than 30°F apart.

1305.3.5.3 Hydronic (Water Loop) Heat Pump Systems: Hydronic heat pumps connected to a common heat pump water loop with central devices for heat rejection and heat addition shall have controls that are capable of providing a heat pump water supply temperature dead band of at least 20°F between initiation of heat rejection and heat addition by the central devices. If a closed-circuit cooling tower is used, either an automatic valve shall be installed to bypass all but a minimal flow of water around the tower, or low leakage positive closure dampers shall be provided. If an open-circuit cooling tower is used directly in the heat pump loop, an automatic valve shall be installed to bypass all heat pump water flow around the tower. If an open-circuit cooling tower is used in conjunction with a separate heat exchanger to isolate the cooling tower from the heat pump loop, then heat loss shall be controlled by shutting down the circulation pump on the cooling tower loop. Each hydronic heat pump on the hydronic system having a total pump system power exceeding ten hp shall have a two-position valve.

Exception: Where a system loop temperature optimization controller is installed and can determine the most efficient operating temperature based on real time conditions of demand and capacity, dead bands of less than 20°F shall be permitted.

1305.3.5.4 Hydronic Variable Flow Systems: HVAC pumping systems that include control valves designed to modulate or step open and closed as a function of load shall be designed for variable fluid flow and be capable of reducing pump flow rates to 50% or less of the design flow rate.

1305.3.5.5Maximum Power Use: Individual pumps serving variable flow systems having pump motors greater than 50 hp shall include controls that are capable of limiting pump motor demand to no more than 30% of design power input at 50% of design water flow.

1305.3.6 Ventilation: Ventilation, either natural or mechanical, shall be provided in accordance with the mechanical code listed in *Appendix A*. Where mechanical ventilation is provided the system shall provide the capability to reduce the outdoor air supply to the minimum required by the mechanical code listed in *Appendix A*.

1305.3.6.1 System Controls: Mechanical ventilation systems shall be provided with manual or automatic controls that will allow the fan system to operate whenever the spaces served are occupied. Air conditioning systems that supply required ventilation air shall be provided with controls designed to automatically maintain the required outdoor air supply rate during occupancy.

1305.3.6.2 Ventilation Controls for High-Occupancy Areas: Systems with design outside air capacities greater than 3000 cfm serving areas having an average design occupancy density exceeding 100 people per 1000 ft^2 shall include means to automatically reduce outside air intake below design rates when spaces are partially occupied. Ventilation controls shall be in compliance with *ASHRAE Standard 62* and local standards.

Exception: fan systems with energy recovery.

1305.3.6.3 Distributed Fan Systems: Where mechanical ventilation is provided by multiple fan systems located in a plenum or other enclosed space, outdoor air shall be ducted directly to each individual fan system.

1305.3.6.4 Outdoor Air Intake Control: Variable air volume systems shall have controls that are capable of maintaining total system outdoor airflow at not less than 90% of the outdoor air supply rates required by 780 CMR 1305.3.6.

1305.3.6.5 Zone Minimum Air Flow: Variable air volume zone controls shall maintain the hourly average outdoor supply air rate at not less than the minimum supply rate required by 780 CMR 1305.3.6 under any thermal load condition expected to occur when the spaces served are occupied.

1305.3.6.6 Shutoff Damper Controls: Both outdoor air supply and exhaust ducts associated with the mechanical ventilation system shall be equipped with motorized dampers that will automatically shut when the systems or spaces served are not in use.

Exception:

1. Gravity (non-motorized) dampers installed in buildings less than three stories in height above grade.
2. Individual supply systems with an outside air intake or exhaust capacity of 300 cfm or less.

1305.3.7 Economizers: Each cooling system including the fan with a total cooling capacity of at least 65,000 Btu/h shall have an air or water economizer.

Cooling fan systems with a total cooling capacity less than 65,000 Btu/hr shall have an air or water economizer in buildings three stories and taller where the total cooling capacity of all such systems exceeds 2,400,000 Btu/h or 10% of the total installed cooling capacity, whichever is larger.

Exception:

1. Systems that include gas phase air cleaning in order to meet ventilation requirements.
2. Where more than 25% of the air designed to be supplied by the system is to spaces that are designed to be humidified above 35°F (2°C) dewpoint temperature in order to satisfy process needs.
3. Systems that include a condenser heat recovery system complying with 780 CMR 1305.3.12.
4. Systems that serve residential spaces where the system capacity is less than 325,000 cfm.
5. Systems that serve spaces whose sensible cooling load at design conditions, excluding transmission and infiltration loads, is less than or equal to transmission and infiltration losses at an outdoor temperature of 60°F.
6. Systems expected to operate less than 20 hours per week.
7. Where the use of outdoor air for cooling will affect supermarket open refrigerated casework systems.

1305.3.7.1 Air Economizers: Air economizers shall be designed to modulate outside air and return air dampers to provide up to the design supply air quantity as outside air.

Economizer dampers shall be capable of being sequenced with the mechanical cooling equipment and shall be controlled by other than mixed air temperature alone. The use of mixed air temperature limit control shall be permitted for systems controlled from space temperature (such as single-*zone* systems).

Air economizers shall be designed to automatically reduce the minimum supply of outside air to the minimum quantities required by 780 CMR 1305.3.6 when the use of outside air will no longer reduce cooling energy usage. Means shall be provided to relieve or exhaust excess return air during air economizer operation. The relief air outlet shall be located to avoid reintroduction of exhaust air into the building.

Controls shall be permitted to be installed to reduce the quantity of outdoor air to prevent coil frosting at the lowest stage of compressor unloading.

1305.3.8 Duct and Plenum Insulation and Sealing: All supply and return air ducts and plenums shall be insulated with a minimum of R-5 insulation when located in *unconditioned spaces* and with a minimum of R-8 insulation when located outside the building envelope. When located within a building envelope assembly the duct or plenum shall be separated from the building exterior or unconditioned or exempt spaces by a minimum R-5 insulation. Required R-values are the "labeled" R-values for such ducts.

Exception:

1. When located within equipment.
2. When the design temperature difference between the interior and exterior of the duct or plenum does not exceed 15°F.
3. Exhaust air ducts.
4. Outside air supply ducts located outside of the building envelope.

All joints, longitudinal and transverse seams, and connections in duct work, shall be securely fastened and sealed with welds, gaskets, mastics (adhesives), mastic-plus-embedded-fabric systems, or tapes. Tapes and mastics used with rigid fibrous glass ducts shall be listed and labeled in accordance with UL 181A. Tapes and mastics used with flexible air ducts shall be listed and labeled in accordance with UL 181B. Duct tape is not permitted as a sealant on any metal ducts.

Ducts designed to operate at static pressures in excess of three in. w.c. shall be leak-tested in accordance with the SMACNA HVAC air duct leakage test manual with the rate of air leakage less than or equal to 6.0 as determined in accordance with Equation 1305.3.8.

$$L_{max} = C_L P^{0.65}$$

Where:

L_{max} = the maximum permitted leakage in cfm per 100 ft^2 duct surface

C_L = 6 for square/rectangular sheetmetal or fibrous ducts, three for round/oval sheetmetal, fibrous or flexible ducts

P = test pressure which shall be equal to the design duct pressure class rating in inches w.c.

1305.3.9 Piping Insulation: All piping serving as part of a heating or cooling system shall be thermally insulated in accordance with Table 1305.3.9.

Exception:

1. Factory-installed piping within HVAC equipment tested and rated in accordance with 780 CMR 1305.3.3.
2. Piping that conveys fluids that have a design operating temperature range between 55°F and 105°F
3. Piping that conveys fluids that have not been heated or cooled through the use of fossil fuels or electrical power.
4. Hot water runout piping not exceeding 4 ft. in length and 1 in. in diameter or less between the control valve and HVAC coil.

Table 1305.3.9
Minimum Pipe Insulation Thickness[a]

Fluid Design Operating Temp. Range (°F)	Insulation Conductivity		Nominal Pipe or Tube Size (in.)				
	Conductivity Btu*in./(h*ft2*°F)	Mean Rating Temp. (°F)	< 1	1 to <1½	1½ to < 4	4 to < 8	≥ 8
Heating Systems (Steam, Steam Condensate and Hot Water)							
>350	0.32-0.34	250	2.5	3.0	3.0	4.0	4.0
251-350	0.29-0.32	200	1.5	2.5	3.0	3.0	3.0
201-250	0.27-0.30	150	1.5	1.5	2.0	2.0	2.0
141-200	0.25-0.29	125	1.0	1.0	1.0	1.5	1.5
105-140	0.22-0.28	100	0.5	0.5	1.0	1.0	1.0
Domestic and Service Hot Water Systems							
105 and Greater	0.22-0.28	100	0.5	0.5	1.0	1.0	1.0
Cooling Systems (Chilled Water, Brine, and Refrigerant)							
40-60	0.22-0.28	100	0.5	0.5	1.0	1.0	1.0
Below 40	0.22-0.28	100	0.5	1.0	1.0	1.0	1.5

[a] For insulation outside the stated conductivity range, the minimum thickness (T) shall be determined as follows:

$$T = r\{(1 + t/r)^{K}/k$$

Where:

T = minimum insulation thickness (in.),

r = actual outside radius of pipe (in.),

t = insulation thickness listed in this table for applicable fluid temperature and pipe size,

K = conductivity of alternate material at mean rating temperature indicated for the applicable fluid temperature [Btu*in.(h*ft^2*°F)]; and

k = the upper value of the conductivity range listed in this table for the applicable fluid temperature.

1305.3.10 Fan System Power: The ratio of the nameplate *fan system power* to the supply fan air flow rate of each HVAC system at design conditions shall not exceed the requirements shown in Table 1305.3.10. *Fan system power* shall be adjusted in accordance with Equation 1305.3.10 for the additional power required by process loads, air treatment or filtering systems with design pressure drops over one in. w.c. when filters are clean, heat recovery coils or devices, or direct evaporative humidifiers/coolers.

Equation 1305.3.10

Adjusted fan system power = *Fan system power* - HP Credit

$$\text{HP Credit (hp)} = \text{Sum of } [CFM_n \times (SP_n - 1.0)/3718] + \text{Sum of } [CFM \times SP_{HR}/3718]$$

Where:

CFM_n =Supply air volume of the unit with the filtering system, cfm

SP_n = Air pressure drop of the filtering system when filters are clean, in. w.c.

SP_{HR} = Air pressure drop of heat recovery coils or direct evaporative humidifier/cooler, in. w.c.

Table 1305.3.10
Fan Power Limitation

Supply Air Volume	Allowable Nameplate Motor Power	
	Constant Air Volume	Variable Air Volume
< 20,000 cfm	1.2 hp/1,000 cfm	1.7 hp/1,000 cfm
> 20,000 cfm	1.1 hp/1,000 cfm	1.5 hp/1,000 cfm

1305.3.10.1 Variable Air Volume (VAV) Fan Control: Individual VAV fans with motors 25 hp and larger shall have controls or devices that will result in fan motor demand of no more than 30% of design wattage at 50% of design air volume when static pressure set point equals ⅓ of the total design static pressure, based on manufacturer's certified fan data.

Static pressure sensors used to control variable air volume fans shall be placed in a position such that the controller set point is not able to exceed ⅓ the total design fan static pressure. If this results in the sensor being located downstream of splits in primary duct runs, multiple sensors shall be installed in each major duct.

For systems with direct digital control at the zone level, static pressure set points shall be capable of being reset based on the zone requiring the most pressure.

1305.3.10.2 Fan-Powered VAV Boxes: Fan-Powered VAV boxes shall be capable of being controlled to shut off when the primary system is off except as required to maintain the *zone* at setback temperatures.

1305.3.11 Heat Rejection Equipment:

1305.3.11.1 General: 780 CMR 1305.3.11 applies to heat rejection equipment used in comfort cooling systems covered in Table 1305.3.3e.

1305.3.11.2 Fan Speed Control: Each fan associated with a heat rejection device covered in Table 1305.3.3e and powered by a motor of 7.5 hp or larger shall have a fan speed control with the capability to operate that fan at two-thirds of full speed or less, and shall have controls that are capable of automatically changing the fan speed to control the leaving fluid temperature or condensing temperature/ pressure of the heat rejection device.

Exception:

1. Condenser fans serving multiple refrigerant circuits.
2. Condenser fans serving flooded condensers.
3. Up to ⅓ of the fans on a condenser or tower with multiple fans where the lead fans comply with the speed control requirement

1305.3.12 Exhaust Air Energy Recovery: HVAC fan systems that have both a design supply air capacity of 5000 cfm or greater and have a minimum outside air supply of 70% or greater of the design supply air quantity shall have an energy recovery system that is capable of providing a change in the enthalpy or dry-bulb temperature of the outdoor air supply equal to at least 50% of the difference between the outdoor air and return air at design conditions. A heat recovery system bypass shall be provided to permit air economizer operation as required by 780 CMR 1305.3.7.

Exception:

1. Laboratory systems meeting 780 CMR1305.3.13.2.
2. Systems serving spaces which are not cooled and which are heated to less than 60°F.
3. Systems exhausting toxic, flammable, paint exhaust, corrosive fumes, or dust which makes the installation of heat recovery equipment impractical.
4. Commercial kitchen hoods (grease) classified as Type 1 by *NFPA 96*.
5. Where more than 60% of the outdoor heating energy is provided from site-recovered or site solar energy

1305.3.13 Exhaust Hoods:

1305.3.13.1 Kitchen Hoods: Individual kitchen exhaust hoods larger than 5000 cfm shall be provided with make-up air sized for at least 50% of exhaust air volume that is

(a) heated to no more than 60°F and

(b) uncooled or cooled without the use of mechanical cooling.

Exception:

1. Where hoods are used to exhaust ventilation air which would otherwise exfiltrate or be exhausted by other fan systems.
2. Certified grease extractor hoods that require a face velocity no greater than 60 fpm.

1305.3.13.2 Fume Hoods: Buildings with fume hood systems having a total exhaust rate greater than 15,000 cfm shall include at least one of the following features:

1. Variable air volume hood exhaust and room supply systems capable of reducing exhaust and make-up air volume to 50% or less of design values.
2. Direct make-up (auxiliary) air supply equal to at least 75% of the exhaust rate, heated no warmer than 2°F below room set point, cooled to no cooler than 3°F above room set point, no humidification added, and no simultaneous heating and cooling used for dehumidification control.
3. Heat recovery systems to precondition make-up air from fume hood exhaust in accordance with 780 CMR 1305.3.12 Exhaust Air Heat Recovery, without using any exception.

780 CMR 1306.0 SERVICE WATER HEATING

1306.1 General: 780 CMR 1306.0 covers installation of service hot water piping and controls for service water heating equipment.

1306.2 Temperature Controls: Service water heating equipment shall be provided with controls to allow a set point of 110°F for equipment serving dwelling units and 90°F for equipment serving other occupancies. The outlet temperature of lavatories in public facility restrooms shall be limited to 110°F.

1306.3 Heat Traps: Water heating equipment not supplied with integral heat traps and serving non - circulating systems shall be provided with heat traps on the supply and discharge piping associated with the equipment.

1306.4 Service Hot Water Piping Insulation: Piping on return circulation hot water systems, shall be insulated with 1 inch of insulation having a conductivity not exceeding 0.28 Btu per inch/h*ft^2*°F. The first eight feet of piping in *nonrecirculating* systems served by equipment without integral heat traps shall be insulated with 1 inch of insulation having a conductivity not exceeding 0.28 Btu per inch/h*ft^2 *°F.

1306.5 Hot Water System Controls: Circulating hot water systems or heat trace shall have automatic time switches that are capable of being set to turn off the system.

1306.6 Swimming pools:

1306.6.1 Pool Covers: Heated pools shall be equipped with a vapor retardant pool cover on or at the water surface.

Exception: Pools deriving over 60% of the energy for heating from site-recovered energy or solar energy source.

1306.6.2 Pool Heaters: Pool heaters shall meet the efficiency requirements for boilers. Pool heaters fired by natural gas shall not have continuously burning pilot lights.

1306.6.3 On-off Switch: Pool heaters shall be equipped with a readily accessible on-off switch to allow shutting off the heater without adjusting the thermostat setting.

1306.6.4 Time Switches: Time switches shall be installed on swimming pool heaters and pumps.

Exceptions:

1. Where public health standards require 24-hour pump operation.
2. Where pumps are required to operate solar and waste heat recovery pool heating systems.

1306.6.5 Temperature Controls: Heated swimming pools shall be equipped with controls to limit heating water temperatures to not more than 80°F.

Exception: Pools used for therapeutic purposes are exempt when approved by the building official.

1306.7 Space Heating and Water Heating: The use of a gas-fired or oil-fired space heating boiler system to provide the total space heating and water heating for a building is allowed when one of the following conditions is met:

1. The single space heating boiler, or the component of a modular or multiple boiler system that is heating the service water, has a standby loss in Btu/h not exceeding

$$(13.3 \times pmd + 400) / n$$

where pmd is the probable maximum demand in gal/h determined in accordance with the procedures described in generally accepted engineering standards and handbooks and n is the fraction of the year when the outdoor daily mean temperature is greater than 64.9°F.

The standby loss is to be determined for a test period of 24-hour duration while maintaining a boiler water temperature of at least 90°F above ambient, with an ambient temperature between 60°F and 90°F. For a boiler with a modulating burner, this test shall be conducted at the lowest input.

2. It can be demonstrated that the use of a single heat source will provide energy savings compared to separate units.
3. The energy input of the combined boiler and water heater system is less than 150,000 Btu/h.

780 CMR 1307.0 ELECTRIC POWER DISTRIBUTION

1307.1 Scope: Electrical distribution systems shall be designed for the efficient distribution of electrical energy from the service entrance to the points of use.

Exceptions:

1. Buildings in use groups R-3 and R-4 (one-and two-family dwellings).
2. *Emergency power systems.*

1307.2 Electrical Metering: In all multi-family dwellings, each dwelling unit shall be separately metered. Also see 527 CMR 12.00.

Exceptions:

1. Publicly financed housing for the elderly with fuel fired heating systems, with centrally operated air conditioning systems, or without air conditioning systems are exempt from this requirement.
2. Publicly financed housing for the elderly with electric resistance or storage heating systems are exempt from this requirement provided there is informational metering of the individual dwelling units.

1307.3 Voltage Drop:

1307.3.1 Feeders: *Feeder conductors* shall be designed for a maximum *voltage drop* of 2% at the design load calculated in accordance with 780 CMR 2701.0.

1307.3.2 Branch Circuits: *Branch circuit* conductors shall be designed for a maximum *voltage drop* of 3% at the design load calculated in accordance with 780 CMR 2701.0.

1307.4 Transformers: Single-phase and three-phase dry-type and liquid-filled distribution transformers first installed after December 31, 1999 shall be selected based on rating as described in 780 CMR 1307.4.1 and 1307.4.2.

Exceptions:

1. liquid-filled transformers below ten kVA or dry-type transformers below 15 kVA
2. drive transformers, both AC and DC
3. all rectifier transformers and transformers designed for high harmonics
4. autotransformers
5. non-distribution transformers, such as UPS (Uninterruptible Power Supply) transformers
6. special impedance, regulation, and harmonic transformers
7. sealed and non-ventilated transformers
8. retrofit transformers, machine tool transformers, or welding transformers
9. transformers with tap ranges greater than 15% or frequency other than 60 Hz
10. grounding or testing transformers.

1307.4.1 Liquid-Immersed Transformers: Liquid-immersed *transformers* shall comply with the minimum efficiencies in Table 1307.4.1 as tested and rated in accordance with Section 313 of the Electric Utility Industry Restructuring Act of November 25, 1997 ("NEMA TP1.")

Table 1307.4.1
NEMA Class 1 Efficiency Levels for Liquid-Filled Distribution Transformers

Reference Condition	Temperature	% of Nameplate Load
Load Loss	85°C	50%
No Load Loss	20°C	50%

kVA	Single Phase Efficiency	kVA	Three Phase Efficiency
10	98.3	15	98.0
15	98.5	30	98.3
25	98.7	45	98.5
37.5	98.8	75	98.7
50	98.9	112.5	98.8
75	99.0	150	98.9
100	99.0	225	99.0
167	99.1	300	99.0
250	99.2	500	99.1
333	99.2	750	99.2
500	99.3	1000	99.2
667	99.4	1500	99.3
883	99.4	2000	99.4
		2500	99.4

1307.4.2 Dry-Type Transformers:. Dry-type *transformers* shall comply with the minimum efficiencies in Table 1307.4.2 as tested and rated in accordance with NEMA TP 1:

Table 1307.4.2
NEMA Class 1 Efficiency Levels for Dry-Type Distribution Transformers

Reference Condition	Temperature	% of Nameplate Load
Low Voltage	75°C	35%
Medium Voltage	75°C	50%

Single Phase Efficiency			Three Phase Efficiency		
kVa	Low Voltage	Medium Voltage	kVa	Low Voltage	Medium Voltage
15	97.7	97.6	15	97.0	96.8
25	98.0	97.7	30	97.5	97.3
37.5	98.2	98.1	45	97.7	97.6
50	98.3	98.2	75	98.0	97.9
75	98.5	98.4	112.5	98.2	98.1
100	98.6	98.5	150	98.3	98.2
167	98.7	98.7	225	98.5	98.4
250	98.8	98.8	300	98.6	98.5
333	98.9	98.9	500	98.7	98.7
500	--	99.0	750	98.8	98.8
667	--	99.0	1000	98.9	98.9
833	--	99.1	1500	--	99.0
			2000	--	99.0
			2500	--	99.1

780 CMR 1308.0 LIGHTING SYSTEMS

1308.1 General: The lighting criteria in 780 CMR 1308.0 shall apply to lighting for the following:

1. interior spaces of *buildings*;
2. exterior building features, including facades, illuminated roofs, architectural features, entrances, exits, loading docks, and illuminated canopies; and,
3. exterior building grounds lighting provided through the *building's* electrical *service*.

Exceptions:

1. emergency lighting that is automatically off during normal *building* operation and is powered by battery, generator, or other alternate power source; and,
2. lighting within living units of residential buildings;
3. lighting that is specifically designated as required by a health or life safety statute, ordinance, or regulation;
4. decorative gas lighting systems.

1308.2 Lighting Control:

1308.2.1 Automatic Lighting Shutoff: Interior lighting in *buildings* larger than 5000 ft^2 shall be controlled with an *automatic control device* to shut off *building* lighting in all spaces. This *automatic control device* shall function on either:

1. a scheduled basis using a time of day operated control device that turns lighting off at specific programmed times. An independent program schedule shall be provided for areas of no more than 25,000 ft^2 but not more than one floor; or
2. an occupant sensor that shall turn lighting off within 30 minutes of an occupant leaving a space; or
3. an unscheduled basis by occupant intervention.

Exception 1: Lighting intended for 24 hour operation shall not require an Automatic Control Device.

Exception 2: Automatic Control Devices are not required in the following spaces: corridors, hallways, stairways and lobbies which are part of a required means of egress; restrooms; mechanical rooms, and; electrical rooms. If automatic control devices are used in the spaces listed, they shall not reduce illumination below the levels prescribed in 780 CMR 1024.0 (Means of Egress Lighting.)

1308.2.2 Space Control: Each space enclosed by ceiling-height partitions shall have at least one *control device* to independently *control* the *general lighting* within the space. Each *control device* shall be activated either manually by an occupant or automatically by sensing an occupant. Each *control device* shall:

1. *control* a maximum of 2,500 ft^2 area for a space 10,000 ft^2 or less, and a maximum of 10,000 ft^2 area for a space greater than 10,000 ft^2,
2. be capable of overriding the shutoff *control* required in 1308.2.1 for no more than two hours, and
3. be readily accessible and located so the occupant can see the controlled lighting.

Exception 1: Remote location shall be permitted for reasons of safety or security when the remote control device has an indicator pilot light as part of or next to the control device and it shall be clearly labeled to identify the controlled lighting.

Exception 2: Means of egress lighting which provides the minimum illumination identified in 780 CMR 1308.2.1 Exception 2 shall be controlled in accordance with 780 CMR 1024.

1308.2.3 Uniform Reduction: Each perimeter office space enclosed by ceiling-height partitions shall have a manual control to allow the occupant to uniformly reduce the connected lighting load by at least 50%

Exception: Spaces with automatic daylighting controls.

1308.2.4 Additional Control:

1. Display/Accent Lighting - display or accent lighting shall have a separate *control device*.
2. Case Lighting - lighting in cases used for display purposes shall be equipped with a separate *control device*.
3. Hotel and Motel Guest Room Lighting - hotel and motel guest rooms and guest suites shall have a master *control device* at the main room entry that *controls* all *permanently installed luminaires* and switched receptacles.
4. Task Lighting - supplemental task lighting including *permanently installed* undershelf or undercabinet lighting shall have a *control device* integral to the *luminaires* or shall be controlled by a wall- mounted *control device* provided the *control device* complies with 780 CMR 1308.2.2.
5. Nonvisual Lighting - lighting for nonvisual applications, such as plant growth and food-warming, shall be equipped with a separate control *device*.
6. Demonstration Lighting - *lighting equipment* that is for sale or for demonstrations in lighting education shall be equipped with a separate *control device*.

1308.2.5 Exterior Lighting Control: Lighting for all exterior applications not exempted in 780 CMR 1308.1 or 1308.7 shall be controlled by a photosensor or astronomical time switch that is capable of automatically turning off the exterior lighting when sufficient daylight is available or the lighting is not required.

Exception: Lighting for covered vehicle entrances or exits from buildings or parking structures where required for safety, security or eye adaptation.

1308.3 Tandem Wiring: Luminaires designed for use with one or three linear fluorescent lamps greater than 30 W each shall use two lamp tandem-wired ballasts in place of single lamp ballasts when two or more luminaires are in the same space and on the same control device.

Exceptions:

1. recessed luminaires more than ten ft apart measured center to center,
2. surface mounted or pendant luminaires which are not continuous,
3. luminaires using single lamp high-frequency electronic ballasts,
4. luminaires using three lamp high-frequency electronic ballasts or three lamp electromagnetic ballasts,
5. luminaires on emergency circuits,
6. luminaires with no available pair.

1308.4 Exit Signs: Exit sign *luminaires* operating at greater than 20 watts shall have a minimum source efficacy of 35 lm/W.

1308.5 Exterior Building Grounds Lighting: All exterior building grounds luminaires which operate at greater than 100 watts shall contain lamps having a minimum efficacy of 60 lm/W unless the luminaire is controlled by a motion sensor or qualifies for one of the exceptions under 780 CMR 1308.1 or 1308.7.

1308.6 Interior Lighting Power: The *installed interior lighting power* identified in accordance with 780 CMR 1308.6.1 shall not exceed the *interior lighting power allowance* developed in accordance with 780 CMR 1308.6.2.

1308.6.1 Installed Interior Lighting Power: The *installed interior lighting power* shall include the power of all *lighting*. The *installed interior lighting power* includes all power used by the *luminaires*, including *lamps*, *ballasts*, current regulators, and *control devices*.

Exceptions:

1. If two or more independently operating lighting systems in a space are capable of being controlled to prevent simultaneous user operation, the installed interior lighting power shall be based solely on the lighting system with the highest wattage.
2. The following *lighting equipment* and applications shall not be considered when determining the *interior lighting power allowance* developed in accordance with 780 CMR 1308.6.2, nor shall the wattage for such lighting be included in the *installed interior lighting power*. However, any such lighting shall not be exempt unless it is an addition to general lighting and is controlled by an independent *control device*.
   a. Lighting in spaces specifically designed for use by the visually impaired.

b. Lighting in *retail* display windows, provided the display area is enclosed by ceiling-height partitions.
c. Lighting in interior spaces that have been specifically designated as a registered interior *historic* landmark.
d. Athletic playing areas with permanently installed lighting for television broadcasting.
e. Casino gambling areas.

3. The following *lighting equipment* shall not be included in the *installed interior lighting power*. However, any such lighting shall not be exempt unless it is an addition to general lighting and is controlled by an independent *control device*.
a. Display or accent lighting that is an essential element for the function performed in galleries, museums, and monuments.
b. Lighting that is integral to *equipment* or instrumentation and is installed by its *manufacturer*.
c. Lighting specifically designed for use only during medical or dental procedures and lighting integral to medical *equipment*.
d. Lighting integral to both open and glass enclosed refrigerator and freezer cases.
e. Lighting integral to food warming and food preparation *equipment*.
f. Lighting for plant growth or maintenance.
g. Lighting that is an integral part of advertising or directional signage.
h. Exit signs.
i. Lighting that is for sale or lighting educational demonstration *systems*.
j. Lighting for theatrical purposes, including, performance, stage, and film and video production.

1308.6.1.1 Luminaire Wattage: Luminaire wattage incorporated into the installed interior lighting power shall be determined in accordance with the following criteria:

1. the wattage of incandescent or tungsten-halogen luminaires with medium screw base sockets and not containing permanently installed ballasts shall be the maximum labeled wattage of the luminaire.

Exceptions:
1. Luminaires for which lower wattage lamps are specified in construction documents, maintenance and operating manuals, and reports specified in 780 CMR 1301.8.4.
2. the wattage of luminaires with permanently installed or remotely installed ballasts shall be the operating input wattage of the specified lamp/ballast combination based on values from manufacturers catalogs or values from independent testing lab reports.
3. the wattage of line voltage lighting track and plug-in busway that allow the addition and/or relocation of luminaires without altering the wiring of the system shall be the lower of:
a. the specified wattage of the luminaires included in the system with a minimum of 30 W/lin ft.
b. the specified wattage of the circuit protection device.

4. the wattage of low-voltage lighting track, cable conductor, rail conductor, and other flexible lighting systems that allow for the addition and/or relocation of luminaires without altering the wiring of the system shall be the specified wattage of the transformer supplying the system.
5. the wattage of all other miscellaneous lighting equipment shall be the specified wattage of the equipment.

1308.6.2 Interior Lighting Power Allowance: The *interior lighting power allowance* for a *building* or a separately metered or permitted portion of a *building* shall be determined by either the *building* area method described in 780 CMR 1308.6.2.1 or the Space-by-Space method described in 780 CMR 1308.6.2.2. Trade-offs of *interior lighting power allowance* among portions of the *building* for which a different method of calculation has been used are not permitted.

1308.6.2.1 Building Area Method of Calculating Interior Lighting Power Allowance: The Building Area Method shall be used only in the following cases: a) projects involving the entire building, or b) projects involving a single, independent, and separate occupancy in a multi-occupancy building. Use the following steps to determine the interior lighting power allowance by the Building Area Method:

1. Determine the appropriate building type from Table 1308.6.2.1 and the allowed lighting power density (watts/unit area) from the building area method column. For building types not listed, selection of a reasonably equivalent type shall be permitted.
2. Determine the gross lighted floor area (square feet) of the *building*.
3. The *interior lighting power allowance* is the product of the lighted floor area of the *building* times the *lighting power density*.

Table 1308.6.2.1
Lighting Power Densities Using the Building Area Method

Building Type	Lighting Power Density (W/ft ^{2})
Automotive Facility	1.5
Convention Center	1.4
Courthouse	1.4
Dining: Bar Lounge/leisure	1.5
Dining: Cafeteria/fast Food	1.8
Dining: Family	1.9
Dormitory	1.5
Exercise Center	1.4
Gymnasium	1.7
Hospital/healthcare	1.6
Hotel	1.7
Library	1.5
Manufacturing	2.2
Motel	2.0
Motion Picture Theatre	1.6
Multi-family	1.0
Museum	1.6
Office	1.3
Parking Garage	0.3
Penitentiary	1.2
Performing Arts Theater	1.5
Police/fire Station	1.3
Post Office	1.6
Religious Buildings	2.2
Retail	1.9
School/university	1.5
Sports Arena	1.5
Town Hall	1.4
Transportation	1.2
Warehouse	1.2
Workshop	1.7

1308.6.2.2 Space-by-Space Method of Calculating Interior Lighting Power Allowance: Use the following steps to determine the interior lighting power allowance by the space-by-space method:

1. For each space enclosed by partitions 80% or greater than ceiling height, determine the gross interior floor area by measuring to the center of the partition wall. Include the floor area of balconies or other projections. Retail spaces do not have to comply with the 80% partition height requirements.
2. Determine the *interior lighting power allowance* for each space from Table 1308.6.2.2. Multiply the floor area(s) of the space(s) times the allowed *lighting power density* for the space type that most closely represents the proposed use of the space(s). The product is the *lighting power allowance* for the space(s). For space types not listed, selection of a reasonable equivalent category shall be permitted.
3. The *interior lighting power allowance* is the sum of *lighting power allowances* of all spaces. Trade-offs among spaces are permitted provided that the total *installed interior lighting power* does not exceed the *interior lighting power allowance*.

Table 1308.6.2.2
Lighting Power Densities Using the Space-by-Space Method

Building Type	Area/Space Type	LPD (W/ft2)
Common Space Types		
	Active Storage	1.1
	Atrium - First Three Floors	1.3
	Atrium - Each Additional Floor	0.2
	Classroom/Lecture/Training	1.6
	Conference/Meeting/Multipurpose	1.5
	Corridor/Transition	0.7
	Dining Area	1.4
	Electrical/Mechanical	1.3
	Food Preparation	2.2
	Inactive Storage	0.3
	Lobby	1.8
	Lounge/Recreation	1.4
	Office - Enclosed	1.5
	Office - Open Plan	1.3
	Restroom	1.0
	Stairway	0.9
	Laboratory	1.8
Athletics		
	Audience/Seating Area	0.5
	Court Sports Area	4.3
	Dressing/Locker/Fitting Room	0.8
	Exercise Area	1.1
	Indoor Playing Field	1.9
	Playing Area	1.9
	Ring Sports Area	3.8
Transportation		
	Baggage Area	1.3
	Terminal Concourse	0.7
	Ticket Counter	1.8
	Transportation Seating Area	1.0
Hospitality & Food Service		
	Bar Lounge/Leisure Dining Area	1.2
	Cafeteria/Fast Food Dining Area	1.4
	Family Restaurant Dining Area	2.2
	Hotel Lobby	1.7
Government & Public Safety		
	Confinement Cell	1.1
	Court House/Police Station Audience/Seating Area	1.6
	Courtroom	2.1
	Fire Station Engine Room	0.9
	Fire Station Sleeping Quarters	1.1
	Judges Chamber	1.1
	Penitentiary Audience/Seating Area	1.9
	Penitentiary Classroom/Lecture/Training	1.4
	Post Office Sorting Area	1.7
Hospital & Healthcare		
	Active Storage - Hospital	2.9
	Corridors w/ Patient Waiting, Exam	1.6
	Emergency	3.2

Building Type	Area/Space Type	LPD (W/ft2)
Hospital & Healthcare continued		
	Exam/Treatment	1.6
	Laundry/Washing	0.7
	Medical Supplies	3.0
	Nurse Station	1.8
	Nursery	1.0
	Operating Room	7.6
	Patient Room	1.2
	Pharmacy	2.3
	Physical Therapy	1.9
	Radiology	0.4
	Recovery	2.6
Industrial & Auto Service		
	Automobile Garage Service/Repair	1.4
	Detailed Manufacturing	6.2
	Manufacturing Control Room	0.5
	Manufacturing Corridor/Transition	0.5
	Manufacturing Equipment Room	0.8
	Manufacturing General - High Bay	3.0
	Manufacturing General - Low Bay	2.1
	Workshop	2.5
Library & Museum		
	Library Card File & Cataloguing	1.4
	Library Reading Area	1.8
	Library Stacks	1.9
	Museum Active Storage	1.4
	Museum General Exhibition	1.6
	Museum Inactive Storage	1.4
	Museum Restoration	2.5
Retail & Banking		
	Banking Activity Area	2.4
	General Retail Sales Area	2.1
	Mall Concourse	1.8
Public Assembly		
	Convention Center Audience/Seating Area	0.5
	Convention Center Exhibit Space	3.3
	Motion Picture Audience/Seating Area	1.3
	Motion Picture Theatre Lobby	0.8
	Performing Arts Audience/Seating Area	1.8
	Performing Arts Theatre Lobby	1.2
Religious		
	Religious Audience/Seating Area	3.2
	Fellowship Hall	2.3
	Worship - Pulpit, Choir	5.2
Warehouse & Parking		
	Fine Material Storage	1.6
	Garage Parking Area - Attendant Only	0.1
	Garage Parking Area - Pedestrian	0.2
	Medium/Bulky Material Storage	1.1

1308.6.2.3 Additional Interior Lighting Power: When using the Space-by-Space Method, an increase in the *interior lighting power allowance* is allowed for specific lighting functions. Additional lighting power shall be allowed only if the specified lighting is installed, shall be used only for the specified *luminaires*, and shall not be used for any other purpose or in any other space.

An increase in the *interior lighting power allowance* is permitted in the following cases:

1. for spaces in which lighting is specified to be installed in addition to the general lighting for the purpose of decorative appearance, such as chandelier-type luminaries or sconces or for highlighting art or exhibits, provided that the additional lighting power shall not exceed 1.0 W/ft^2 of such spaces.
2. for lighting equipment installed in retail spaces that is specifically designed and directed to highlight merchandise provided that the additional lighting power shall not exceed:
   a. 1.6 W/ft^2 times the area of specific display, or
   b. 3.9 W/ft^2 times the area of specific display for valuable merchandise such as jewelry, fine apparel and accessories, china, crystal and silver, art, and similar items where the detailed display and examination of merchandise are important.

1308.7 Exterior Building Lighting Power: The exterior lighting power allowance is the sum of lighting power allowances for all of the applicable exterior applications permitted, other than building facades, provided that the total installed exterior lighting power does not exceed the exterior lighting power allowance. Exterior lighting for all other applications (except those included in the Exceptions to 780 CMR 1308.7) shall comply with the requirements of 780 CMR 1308.5.

Table 1308.7
Lighting Power Limits for Building Exteriors

Applications	Power Limits
Building entrance with canopy or free standing canopy	3 W/ft^2 of canopied area
Building entrance without canopy	33 W/lin ft of door width
Building exit	20 W/lin ft of door width
Building facades	0.25 W/ft^2 of illuminated *façade area*

Exceptions: Lighting used for the following exterior applications is exempt when equipped with an independent *control device*:

1. specialized signal, directional, and marker lighting associated with transportation;
2. lighting used to highlight features of public monuments and registered *historic* landmark structures or *buildings*;
3 lighting that is integral to advertising signage.

780CMR 1309.0 BUILDING DESIGN BY SYSTEMS ANALYSIS

1309.1 General: 780CMR 1309.0 establishes design criteria in terms of total energy use by a building including all of its systems.

A building designed in accordance with 780CMR 1309.0 will be deemed as complying with 780CMR 13 if the annual energy consumption is not greater than if the building were designed with enclosure elements and energy consuming systems in compliance with 780CMR 1304.0 through 1308.0.

1309.2 Analysis Procedure: The analysis of the annual energy usage of the standard and the proposed alternative building and system design shall meet the following criteria:

1. Energy Analysis: The calculation procedure used to simulate the operation of the building and its service systems through a full year operating period shall be of sufficient detail to permit the evaluation of the effect of system design, climatic factors, operational characteristics, and mechanical equipment on annual energy usage. The calculation procedure shall be based upon 8760 hours of operation of the building and its service systems and shall utilize techniques recommended in the ASHRAE Handbook, 1997 Fundamentals Volume.
2. Climatic data: Coincident hourly data for temperatures, solar radiation, wind and humidity of typical days in the year representing seasonal variation, in accordance with Tables 1303.1 and 1303.2.
3. Energy Sources: Identical energy sources must serve the same purpose in both the standard and the proposed alternative design. If the proposed alternative design results in an increase in consumption of one energy source and a decrease in another energy source, each energy source shall be converted to equivalent Btu units for purposes of comparing the total energy used. Consumption of electricity shall be converted at the rate of 10,000 Btu/kWh for the purpose of this comparison.

4. Nondepletable Energy Sources: Energy collected on site from nondepletable sources shall be omitted from the comparison of total energy used. Energy collected off site from nondepletable sources shall be included in the comparison of total energy used.

5. Building Operation: Building operation shall be simulated for a full calendar year. Operating schedules shall include hourly profiles for daily operation and shall account for variations between weekdays, weekends, holidays, and any seasonal operation. Schedules shall model the time-dependent variations of occupancy, illumination, receptacle loads, thermostat settings, mechanical ventilation, HVAC equipment availability, service hot water usage, and any process loads.

> **Exception**: Operating schedules shall be permitted to differ between the proposed design and the standard design to allow simulation of the impact of any automatic control provided in the proposed design beyond the minimum requirements in 780 CMR 1304 through 1309.

6. Simulated Loads: The following systems and loads shall be modeled in determining total building performance: heating systems; cooling systems; fan systems; lighting power; receptacle loads; and process loads that exceed 1.0 watts per square foot of floor area of the room or space in which the process loads are located.

> **Exception**: Systems required for emergency power only.

7. Service Water Heating Systems: Service water heating systems that are other than combined service hot water/space heating systems shall be permitted to be omitted from the energy analysis provided all requirements of 780 CMR 1306 have been met.

8. Exterior Lighting: Where included in the analysis the exterior lighting systems shall be the same in the standard and proposed designs.

1309.3 Proposed Design: Building systems and loads shall be simulated in the proposed design as follows:

1. HVAC and Service Water Heating Equipment: All HVAC and Service Water Heating Equipment shall be simulated in the proposed design using capacities, rated efficiencies, and part-load performance data for the proposed equipment as provided by the equipment manufacturer.

2. Features Not Documented at Time of Permit: Any feature of the proposed design not included in the construction documents shall be assumed to be equal to the corresponding feature in the standard design.

3. Mandatory Requirements: The proposed design shall meet the requirements of the following without exception:
   a. 780 CMR 1304.1.2 Moisture Control
   b. 780 CMR 1304.2.7 Slabs on Grade
   c. 780 CMR 1304.2.8 Slabs Below Grade
   d. 780 CMR 1304.3 Air Leakage
   e. 780 CMR 1304.4 Insulation General
   f. 780 CMR 1305.3.4 Temperature and Humidity Controls
   g. 780 CMR 1305.3.8 & 9 Distribution System Construction and Insulation
   h. 780 CMR 1307.0 ELECTRIC POWER DISTRIBUTION
   i. 780 CMR 1308.2 Lighting Control

1309.4 Standard Design: The standard design, conforming to the criteria of 780 CMR 1309, and the proposed design, shall be designed on a common basis as specified herein. The comparison shall be expressed as Btu input per square foot of gross floor area per year.

The heating and cooling system zoning, orientation of each building feature, number of floors, and the gross envelope areas of the standard design shall be the same as those of the proposed design.

> **Exception**: Permanent fixed or movable external shading devices for windows and glazed doors shall be excluded from the standard design.

1309.5 Documentation: Proposed alternative designs, submitted as requests for exception to the standard design criteria, shall be accompanied by an energy analysis comparison report prepared by a professional registered engineer or registered architect. The report shall provide sufficient technical detail on the two buildings and systems designs, and on the data used in and resulting from the comparative analysis, to verify that both the analysis and the designs meet the criteria of 780 CMR 13. The documentation shall demonstrate that the analysis used is consistent with ASHRAE calculation procedures and accepted engineering practice.

> **Exception**: Proposed alternative designs for buildings having an area of 5,000 square feet or less and having the indoor temperature controlled from a single point are exempted from the full year energy analysis as described above. A comparison of energy consumption between the alternative design and the standard design shall be provided in a report prepared by a registered professional engineer or architect. Such analysis shall follow the bin or degree day methods or other simplified analysis procedures in ASHRAE 1997 Handbook of Fundamentals.

CHAPTER 14

EXTERIOR WALL COVERINGS

780 CMR 1401.0 GENERAL

1401.1 Scope: The provisions of 780 CMR 14 shall establish the minimum requirements for exterior walls. Exterior walls shall be designed and constructed in accordance with 780 CMR.

780 CMR 1402.0 DEFINITIONS

1402.1 General: The following words and terms shall, for the purposes of 780 CMR 14 and as used elsewhere in 780 CMR, have the meanings shown herein.

Exterior wall finish: A material or assembly of materials applied on the exterior side of exterior walls for the purpose of providing a weather-resisting barrier, insulation or for aesthetics, including veneers, siding, exterior insulation and finish systems, architectural trim and embellishments such as cornices, soffits, facias, gutters and leaders.

Wall

- **Apron wall**: That portion of a skeleton wall below the sill of a window.
- **Skeleton or panel wall**: A nonbearing wall supported by each story on a skeleton frame.
- **Spandrel wall**: That portion of a skeleton wall above the head of a window or door.
- **Veneered wall**: A wall having a facing of masonry or other weather-resistant noncombustible material that is securely attached to the backing, but not so bonded as to exert common action under *load*.

780 CMR 1403.0 PERFORMANCE REQUIREMENTS

1403.1 General: The provisions of 780 CMR 1403.0 shall apply to exterior walls and components thereof.

1403.2 Durability: All exterior walls and components thereof shall be of approved materials which maintain the performance characteristics required herein for the duration of use.

1403.3 Weather resistance: The exterior walls shall be faced with an approved weather-resistant covering that is properly attached to resist wind and rain. The cellular spaces shall be so ventilated as not to vitiate the *firestopping* at floor, *attic* and roof levels, or shall be provided with an approved interior noncorrodible *vapor retarder*, or other approved means to avoid condensation and leakage of moisture.

1403.4 Structural: Exterior walls shall be designed and constructed to resist safely all superimposed *loads* as required by 780 CMR 16.

1403.4.1 Structural strength against wind forces: In all buildings required to resist the wind pressures described in 780 CMR 1611.0, glazing in exterior window openings shall be designed to resist the *wind loads* specified in 780 CMR 1611.0 for components and cladding.

1403.4.2 Structural strength of sash or frames: Mullions, sash and frames of glazed exterior window openings shall be designed to resist the *wind loads* specified in 780 CMR 1611.0 for components and cladding.

1403.5 Fireresistance: All exterior walls shall comply with the fireresistance rating requirements of 780 CMR 705.0.

1403.5.1 Fireresistance rated openings: Openings in exterior walls, where required to have a fire protection rating, shall comply with the provisions of 780 CMR 7.

1403.6 Flood-resistant construction: Exterior walls of structures that are erected in areas prone to flooding shall comply with the provisions of 780 CMR 3107.0.

1403.7 Ratproofing: Exterior walls of buildings that are required to be ratproofed shall comply with the provisions of 780 CMR 1215.0.

780 CMR 1404.0 MATERIALS

1404.1 Wood: Exterior walls of wood construction shall be designed and constructed in accordance with 780 CMR 23.

1404.2 Masonry: Exterior walls of masonry construction shall be designed and constructed in accordance with 780 CMR 21.

1404.3 Metal: Exterior walls of formed steel construction structural steel or lightweight metal alloys shall be assigned in accordance with 780 CMR 22 and 780 CMR 20, respectively.

1404.4 Concrete: Exterior walls of concrete construction shall be designed and constructed in accordance with 780 CMR 19.

1404.5 Structural glass: Exterior walls of structural glass block shall be designed and constructed in accordance with 780 CMR 2115.0.

1404.6 Plastics: *Plastic* panel, apron or spandrel walls as defined in 780 CMR shall not be limited in thickness, provided that such *plastics* and their assemblies conform to the requirements of 780 CMR 26 and are constructed of approved weather-resistant materials of adequate strength to resist the *wind loads* specified in 780 CMR 1611.0.

1404.7 Other: Materials not prescribed herein shall be permitted provided that any such alternative has been approved. Exterior walls constructed of alternative materials shall be shown to be durable, weather resistant, structurally adequate, fireresistant, flood resistant and ratproof as required herein.

780 CMR 1405.0 VENEERS

1405.1 General: All veneers consisting of nonstructural facing of brick, concrete, stone, tile, metal, *plastic*, synthetic stucco or other approved exterior coverings attached to a backing, shall be designed and constructed in accordance with the applicable provisions of 780 CMR 1405.

1405.2 Structural support: Surfaces to which veneer is attached shall be designed to support the additional *loads* imposed by the veneer.

1405.2.1 Backing surfaces for veneers: Veneers for other than buildings of Type 5 construction shall be attached only to substantial, rigid and noncombustible surfaces which are plumb, straight and of true plane. Wood backing surfaces shall not be used, except in buildings of Type 5 construction. The backing shall provide sufficient rigidity, stability and weather resistance, and the veneer shall be installed and anchored as required in 780 CMR for the specific material.

1405.3 Materials: The materials of the minimum nominal thickness specified in Table 1405.3 shall be acceptable as approved weather coverings.

Table 1405.3
MINIMUM THICKNESS OF WEATHER COVERINGS

Covering type	Minimum thickness
Aluminum siding[b]	0.019 inch
Asbestos cement boards	⅛ inch
Asbestos shingles	5/32 inch
Brick and concrete masonry veneers	2 inches
Ceramic veneer (architectural terra cotta, anchored type)	1 inch
Clay tile (flat slab)	¼ to 1 inch
Clay tile (structural)	1¾ inches
Exterior plywood (with sheathing)	5/16 inch
Exterior plywood (without sheathing)	See 780 CMR 2307.0
Glass fiber reinforced concrete panels	⅜ inch
Hardboard siding	¼ inch
Marble slabs	1 inch
Particleboard (with sheathing)	See 780 CMR 2308.5
Particleboard (without sheathing)	See 780 CMR 2308.5
Precast stone facing	⅝ inch
Protected fiber board siding	½ inch
Rigid PVC siding[c]	0.035 inch
Steel (approved corrosion-resistive)	0.017 inch
Stone (cast artificial)	1½ inches
Stone (natural)	2 inches
Structural glass	11/32 inch
Stucco or exterior portland cement plaster	
three-coat work over	
metal plaster base	⅞ inch[b]
unit masonry	⅝ inch[b]
cast-in-place or precast concrete	⅝ inch[b]
Two-coar work over	
unit masonry	½ inch[b]
cast-in-place or precast concrete	⅜ inch[b]
Wood shingles	⅜ inch
Wood siding (without sheathing)[a]	½ inch

Note a. For wood siding of a lesser thickness, see 780 CMR 1405.3.5.

Note b. Exclusive of texture

1405.3.1 Basic hardboard: Basic hardboard shall conform to the requirements of AHA A135.4 listed in *Appendix A*.

1405.3.2 Hardboard siding: Hardboard siding shall conform to the requirements of AHA A 135.6 listed in *Appendix A* and, where used structurally, shall be so identified by an *approved agency*.

1405.3.3 Rigid PVC siding: Rigid PVC siding shall conform to the requirements of ASTM D3679 listed in *Appendix A*.

1405.3.4 Aluminum siding: Aluminum siding shall conform to the requirements of AAMA 1402 listed in *Appendix A*.

1405.3.5 Wood siding: Wood siding of thicknesses less than ½ inch shall be placed over sheathing which conforms to 780 CMR 2305.13.

1405.3.6 Building paper: Where veneers of brick, clay tile, concrete or natural or artificial stone are used, 14-pound felt or paper shall be attached to the sheathing with flashing wherever necessary to prevent moisture penetration behind the veneer.

1405.3.7 Nailing: All weather boarding and wall coverings shall be securely nailed with aluminum, copper, zinc, zinc-coated or other approved corrosion-resistant nails in accordance with the nailing schedule in Table 2305.2 or the approved manufacturer's installation instructions. Shingles and other weather coverings shall be attached with appropriate standard-shingle nails to furring strips securely nailed to studs, or with approved mechanically bonding nails, except where sheathing is of wood not less than one-inch nominal thickness or of wood structural panels not less than 5/16 inch thick. Where wood shingles or shakes are applied over fiberboard shingle backer and fiberboard sheathing, such shingles or shakes shall be attached with approved corrosion-resistant annular-grooved nails and the installation shall be done in accordance with the approved manufacturer's installation instructions. Where wood shingles or shakes and asbestos shingles or siding are nailed directly to nail base fiberboard sheathing, the sheathing shall not be less than ½-inch nominal thickness, the shingles, shakes and siding shall be attached with approved corrosion-resistant annular-grooved nails, and the installation shall be done in accordance with the approved manufacturer's installation instructions.

1405.3.8 Metal siding: Exposed metal siding or sheathing shall be protected from corrosion at the ground level by supporting the foundation channel at sufficient height above grade on the concrete apron or other approved water-resistant foundation.

1405.3.9 Exterior wall pockets: In exterior walls of all buildings or structures, wall pockets or crevices in which moisture can accumulate shall be avoided or protected with adequate caps or drips, or other approved means shall be provided to prevent water damage.

1405.3.10 Flashings: Approved corrosion-resistant flashings shall be provided at the top and sides of all exterior window and door openings in such a manner as to be leakproof Approved corrosion-resistant flashings shall be installed: at the intersection of chimneys or other masonry construction with frame or stucco walls, with projecting lips on both sides under stucco copings; under and at the ends of masonry, wood or metal copings and sills; continuously above all projecting wood trim; at the intersection of exterior walls and porches and decks; at wall and roof intersections; and at built-in gutters.

> **Exception**: When approved, flashing is not required where an approved water-resistant sheathing is installed and an approved water-resistant caulking is applied at the top and sides of all window and door openings in such a manner as to be leakproof.

1405.4 Metal veneers: Veneers of metal shall be fabricated from approved corrosion-resistant materials or shall be protected front and back with porcelain enamel or shall otherwise be treated to render the metal resistant to corrosion. Such veneers shall not be less than 0.017-inch nominal thickness galvanized sheet steel mounted on wood or metal furring strips or approved sheathing on the wood construction.

1405.4.1 Construction: Metal veneer for buildings of other than Type 5 construction shall be: securely attached to masonry; supported on approved metal framing protected by painting, galvanizing or other approved protection; or supported by wood furring strips treated with an approved *preservative* process that complies with 780 CMR 2311.3.

1405.4.2 Waterproofing: All joints and edges exposed to the weather shall be caulked with approved durable waterproofing material or by other approved means to prevent penetration of moisture.

1405.4.3 Grounding metal veneers: Grounding of metal veneers on all buildings shall comply with the requirements of 780 CMR 27 and 527 CMR listed in ***Appendix A***.

1405.5 Anchored masonry veneer: Anchored veneer is veneer secured with approved mechanical fasteners to an approved backing. All masonry units, mortar and metal accessories used in anchored veneer shall meet the physical requirements of 780 CMR 21. Anchored veneer units shall not be less than 1⅝ inches (41 mm) in actual thickness for solid masonry units and not less than 2⅝ inches (67 mm) in actual thickness for hollow masonry units.

1405.5.1 Height of anchored veneer: Anchored veneer shall be supported on footings, foundation walls or other approved noncombustible structural supports or on wood foundations meeting the requirements of 780 CMR 1808.3. The weight of all anchored veneer installed on structures more than 30 feet (9144 mm) in height above the noncombustible foundation or support, with the exception of concrete masonry veneers, shall be supported by noncombustible construction. The construction shall have horizontal supports located at each story height above the initial 30 feet (9144 mm).

> **Exception**: Height increases are permitted where an engineering analysis is prepared by a *registered design professional* and approved.

1405.5.2 Horizontal supports: Noncombustible lintels and noncombustible supports shall be provided over all openings. Beams and lintels supporting unreinforced masonry veneer shall not exceed 1/600 of the span nor 0.3 inches (8 mm).

1405.5.3 Wood frame: Masonry veneer anchored to wood framing shall be attached with corrosion-resistant corrugated sheet metal not less than 0.029 inch (No. 22 gage) by ⅞ inch wide, or corrosion-resistant ties of strand wire not less than 0.148-inch (No.9 W&M gage) wire with the ends of the wire bent to a 90-degree (1.57 rad) angle to form a hook not less than two inches (51 mm) long. The metal ties shall be embedded in the mortar joint a minimum of one-half the veneer thickness. Each metal tie shall support not more than three square feet (0.28 m^2) of wall area with a maximum spacing of 16 inches (406 mm) vertically and 32 inches (813 mm) horizontally. Where anchored veneer is applied over wood frame, the studs shall be spaced a maximum of 24 inches (610 mm) on center and be faced with sheathing on both sides. A one-inch (25 mm) minimum air space shall be maintained between the anchored veneer and the sheathing. Moisture protection shall be provided as required by 780 CMR 1405.3.6.

1405.5.4 Steel frame: Masonry veneer anchored to corrosion-resistant steel framing shall be attached with corrosion-resistant ties of strand wire not less than 0.148-inch (No. 9 W&M gage) wire with the ends of the wire bent to a 90-degree (1.57 rad) angle to form a hook not less than two inches (51 mm) long. The wire ties shall be embedded in the mortar joint a minimum of one-half the veneer thickness. Each metal tie shall support not more than 2.67 square feet (0.25 m^2) of wall area with a maximum spacing of 16 inches (406 mm) vertically and 24 inches (610 mm) horizontally. Where anchored veneer is applied over steel frame, the studs shall be spaced a maximum of 24 inches (610 mm) on center and be faced with sheathing on both sides. A one-inch (25 mm) minimum air space shall be maintained between the anchored veneer and the sheathing. Moisture protection shall be provided as required by 780 CMR 1405.3.6.

1405.5.5 Masonry or concrete walls: Masonry veneer anchored to masonry or concrete walls shall be attached with corrosion-resistant ties of strand wire not less than 0.148-inch (No. 9 W&M gage) wire with the ends of the wire bent to a 90-degree (1.57 rad) angle to form a hook not less than two inches (51 mm) long. The metal ties shall be embedded in the mortar joint a minimum of one-half the veneer thickness. Each metal tie shall support not more than three square feet (0.28 m^2) of wall area with a maximum spacing of 16 inches (406 mm) vertically and 32 inches (813 mm) horizontally. A one-inch (25 mm) minimum air space shall be maintained between the anchored veneer and the supporting masonry or concrete walls.

1405.5.6 Stone veneer: Stone veneer units not exceeding ten inches in thickness are permitted to be anchored directly to masonry, concrete or to stud construction by one of the following methods.

1. With concrete or masonry backing, anchor ties shall not be less than No. 12 gage corrosion-resistant wire formed beyond the base of the backing. The legs of the loops shall not be less than six inches (153 mm) in length bent at right angles and laid in the mortar joint and spaced so that the eyes or loops are 12 inches (305 mm) maximum on center in both directions. There shall be provided not less than a No.12 gage corrosion-resistant wire tie threaded through the exposed loops for every two square feet (0.186 m^2) of stone veneer. This tie shall be a loop having legs not less than 15 inches (381 mm) in length bent so that the tie will lie in the stone veneer mortar joint. The last two inches (51 mm) of each wire leg shall have a right-angle bend. One inch (25 mm) of cement grout shall be placed between the backing and the stone veneer.
2. With stud backing, a two-inch by two-inch No. 16 gage corrosion-resistant wire mesh with two layers of waterproof paper backing shall be applied directly to wood studs spaced a maximum of 16 inches (406 mm) on center. On studs, the mesh shall be attached with two-inch-long (51mm) corrosion-resistant steel wire furring nails at four inches (102 mm) on center providing a minimum 1⅛-inch (28 mm) penetration into each stud and with 8d common nails at eight inches (200 mm) on center into top and bottom plates. The corrosion-resistant wire mesh is permitted to be attached to steel studs with equivalent wire ties. There shall not be less than a No. 12 gage corrosion-resistant wire, looped through the mesh for every two square feet (0.186 m^2) of stone veneer. This tie shall be a loop having legs not less than 15 inches (38 mm) in length, so bent that the tie will lie in the stone veneer mortar joint. The last two inches (51 mm) of each wire leg shall have a right-angle bend. One-inch (25 mm) minimum thickness of cement grout shall be placed between the backing and the stone veneer.

1405.5.7 Slab-type veneer: Slab-type veneer units not exceeding two inches (51 mm) in thickness are permitted to be anchored directly to masonry, concrete or stud construction. For veneer units of marble, travertine, granite or other stone units of slab form, ties of corrosion-resistant dowels in drilled holes shall be located in the middle third of the edge of the units spaced a maximum of 24 inches (610 mm) apart around the perimeter of each unit with not less than four ties per veneer unit. Units shall not exceed 20 square feet (1.86 m^2) in area.

If the dowels are not tight fitting, the holes are permitted to be drilled not more than 1/16 inch (1.6 mm) larger in diameter than the dowel with the hole countersunk to a diameter and depth equal to twice the diameter of the dowel in order to provide a tight-fitting key of cement mortar at the dowel locations when the mortar in the joint has set. All veneer ties shall be corrosion-resistant metal capable of resisting in tension or compression a force equal to two times the weight of the attached veneer.

Sheet metal veneer ties shall not be smaller in area than No. 22 gage by one inch. Wire veneer ties shall not be smaller in diameter than No. 9 gage wire.

1405.5.8 Terra cotta or ceramic veneer: Anchored terra cotta or ceramic units not less than 1⅝ inches thick are permitted to be anchored directly to masonry, concrete or stud construction. Tied terra cotta or ceramic veneer units shall not be less than 1⅝ inches thick with projecting dovetail webs on the back surface spaced approximately eight inches (203 mm) on center. The facing shall be tied to the backing wall with corrosion-resistant metal anchors of not less than No. 8 gage wire installed at the top of each piece in horizontal bed joints not less than 12 inches (305 mm) nor more than 18 inches (457 mm) on center. These anchors shall be secured to ¼-inch corrosion-resistant pencil rods which pass through the vertical aligned loop anchors in the backing wall. The veneer ties shall have sufficient strength to support the full weight of the veneer in tension. The facing shall be set with not less than a two-inch (51 mm) space from the backing wall and the space shall be filled solidly with portland cement grout and pea gravel. Immediately prior to setting, the backing wall and the facing shall be drenched with clean water and shall be damp when the grout is poured.

1405.6 Adhered masonry veneer: Adhered veneer is a veneer secured and supported through the adhesion of an approved bonding material applied to an approved backing. All masonry units used in adhered veneer walls shall meet the physical requirements of 780 CMR 21. Adhered veneer units shall be less than 1⅝ inches thick and the units shall not support any super-imposed *loads*. With the exception of ceramic tile, adhered veneer and backing shall be designed to provide a bond to the supporting element sufficient to withstand a shearing stress of 50 psi (344 kPa) after curing 28 days.

1405.6.1 Backing surface: Backing permitted for adhered veneer shall be continuous and shall be of any approved material. The backing shall have surfaces prepared to secure and support the imposed *loads* of the adhered veneer.

1405.6.2 Height of adhered veneer: Exterior adhered veneer shall not be attached to wood frame construction at a point more than 30 feet (9144 mm) in height above the noncombustible foundation. Height increases are permitted where an engineering analysis is prepared by a *registered design professional* and approved.

1405.6.3 Sizing of adhered veneer: Adhered veneer units shall not exceed 36 inches (914 mm) in the greatest dimension nor more than 720 square inches (0.46 m^2) in total area and shall not weigh more than 15 pounds per square foot (73 kg/mm^2) unless approved.

Exception: Adhered veneer units weighing less than three pounds per square foot (15 kg/mm^2) shall not be limited in dimension or area.

1405.6.4 Construction: Adhered veneer units shall be adhered directly to the backing by one of the following methods.

1. A paste of neat portland cement shall be brushed on the backing and the back of the veneer unit. Type S mortar shall then be applied to the backing and the veneer unit. Sufficient mortar shall be used to create a slight excess to be forced out the edges of the units. The units shall be tapped into place so as to fill completely the space between the units and the backing. The resulting thickness of mortar in back of the units shall not be less than ½ inch (13 mm) nor more than 1¼ inches (32 mm).
2. Units of masonry, stone or terra cotta, not over one inch in thickness shall be restricted to 81 square inches (0.052 m^2) in area unless the back side of each unit is ground or box screened to true up any deviation from plane. Those units not over two inches by two inches by ⅜ inch in size are permitted to be adhered by means of portland cement. Backing shall be of masonry, concrete or portland cement plaster on metal lath. Metal lath shall be fastened to the supports in accordance with the requirements of 780 CMR 25. Mortar that complies with Table 1405.6.4 shall be applied to the backing as a setting bed. The setting bed shall be a minimum of ⅜ inch (9 mm) thick and a maximum of ¾ inch (19 mm) thick. A paste of neat portland cement or half portland cement and half graded sand shall be applied to the back of the exterior veneer units and to the setting bed and the veneer pressed and tapped into place to provide complete coverage between the mortar bed and veneer unit. A portland cement grout shall be used to point the veneer.

Table 1405.6.4
ADHERED VENEER SETTING MORTAR

Wall Area	Coat	Volume Type I portland cement	Volume Type S portland hydrated lime	Volume sand		Maximum thickness of coat (inches)[a]	Maximum interval between coats (hours)
				Dry	Damp		
Walls over 10 sq. ft.	Scratch	1	½	4	5	⅜	24
		1	0	3	4	⅜	24
	Float or leveling	1	½	4	5	¾	24
		1	1	6	7	¾	24
Walls 10 sq. ft. or less	Scratch & float	1	½	2½	3	⅜ ¾	24

Note a. one inch = 25.4mm; one sq. Ft. = 0.093m^2

1405.6.5 Adhered ceramic tile: Adhered veneer of ceramic tile shall be bonded to the backing as provided for in 780 CMR 2105.10.

1405.6.6 Building paper: Adhered veneer over wood frame construction shall be backed by solid sheathing covered with 14-pound felt building paper as required by 780 CMR 1405.3.6.

1405.7 Structural glass veneers: The minimum thickness of glass veneer shall be 11/32 inch and the area of individual panels shall not exceed ten square feet (0.93 m^2), with a maximum length of four feet (1219 mm). The edge of each unit shall be ground square with a slight arise. All exposed external corners and angles shall he rounded to a radius of not more than 3/16 inch (5 mm).

1405.7.1 Backing surface: The glass veneer shall be set in mastic cement on a float coat of 1-inch-thick (25 mm) cement mortar reinforced with wire lath attached to noncombustible furring spaced not more than 12 inches (305 mm) on center.

1405.7.2 Support of veneer: The base course of glass units shall be supported on a corrosion-resistant metal frame anchored to the backing and caulked with a waterproof compound at grade.

1405.7.3 Reinforcement: Metal reinforcing of cold-formed corrosion-resistant angles of not less than 0.064-inch nominal thickness galvanized sheet steel or other approved reinforcement shall be provided in all horizontal joints anchored into the masonry wall with expansion or toggle bolts.

1405.7.4 Expansion joints: Expansion joints shall be provided at ends and at intermediate sections which are caulked with an approved waterproofing compound. Where necessary for water tightness, exposed edges shall be protected with corrosion-resistant metal or other approved noncombustible flashing.

1405.7.5 Other loads: *Signs*, awning brackets or other *loads* shall not be hung directly from glass veneers, but shall be supported on framing anchored to or otherwise supported by the masonry wall, free from contact with the glass.

780 CMR 1406.0 COMBUSTIBLE MATERIALS ON THE EXTERIOR SIDE OF EXTERIOR WALL

1406.1 General: 780 CMR 1406.0 shall apply to *exterior wall finish*, half-timbering, balconies and similar appendages, and bay and *oriel windows* constructed of combustible materials including light-transmitting *plastic* panels and foam plastic.

1406.2 Combustible exterior wall finish: Combustible *exterior wall finish* shall be tested and installed in accordance with 780 CMR 1406.2.1 through 1406.2.4.

Exceptions
1. Light-transmitting plastic panels shall be constructed and installed in accordance with 780 CMR 26.
2. Foam plastic installed in or on the exterior side of walls of buildings in accordance with 780 CMR 2603.6 shall not be required to comply with 780 CMR 1406.2.1 provided that the foam plastic is protected on the out side by:
    - 2.1. A thermal barrier complying with 780 CMR 2603.4;
    - 2.2. A minimum one-inch (25 mm) thickness of masonry or concrete;
    - 2.3. A minimum ⅞-inch (22 mm) thickness of stucco complying with 780 CMR 2506.0;
    - 2.4. A minimum 0.019-inch thickness of aluminum; or
    - 2.5. A minimum 0.016-inch thickness or corrosion-resistant steel.

1406.2.1 Radiant heat exposure: Combustible *exterior wall finish* shall be tested for exposure to radiant heat. Test specimens shall be prepared in accordance with 780 CMR 1406.2.1.1 and tested in accordance with 780 CMR 1406.2.1.2. The criteria for acceptance shall be as given by 780 CMR 1406.2.1.3.

Exceptions: The testing shall not be required for:
1. Wood or wood-based products.
2. Other combustible materials covered with a material listed in Table 1405.3.
3. Aluminum having a minimum thickness of 0.019 inch.
4. *Exterior wall finish* on exterior walls of Type 5 construction.

1406.2.1.1 Test specimen: The test specimen shall be constructed to reflect the end-use configuration. Where a material is intended to be installed in more than one thickness, tests of the minimum and maximum thickness intended to be used shall be performed. Test specimens shall consist of a minimum four-foot-wide by eight-foot-high assembly which shall be mounted in a vertical position.

1406.2.1.2 Test exposure and apparatus: The test exposure and apparatus shall conform to 780 CMR 1406.2.1.2.1 through 1406.2.1.2.4.

1406.2.1.2.1 Apparatus: A three-foot by three-foot propane-fired radiant panel shall be provided and shall operate at a constant temperature of 1,600°F (871°C) ± 50°F (28°C).

1406.2.1.2.2 Configuration: The radiant panel and the test specimen shall be configured in a parallel plate orientation such that the axis perpendicular to, and running through, the center of the radiant panel face and the test specimen are concurrent.

1406.2.1.2.3 Heat flux: The temperature of the radiant heat panel shall be fixed to produce an average heat flux of 12.5 ± 5% kW/m^2 over the center square foot of the test assembly. Average heat flux shall be determined as the average of four calorimeter readings located at the corners of the center square foot of the test assembly.

1406.2.1.2.4 Exposure: The four-foot by eight-foot test specimen shall be exposed to a "square wave" exposure for a period of 20 minutes. A spark igniter shall be installed and located at a point 18 inches vertically above the center point of the test specimen and ⅝ inch off the face of the test specimen. The spark igniter shall be operated throughout the 20-minute test period. If the spark igniter is operated in an intermittent mode, the "off" portion of the cycle shall not be longer than two seconds and the "on" portion of each cycle shall be at least five seconds in duration.

1406.2.1.3 Conditions of acceptance: Materials shall qualify for installation under the provisions of 780 CMR 1406.2.1.3.1 or 1406.2.1.3.2.

1406.2.1.3.1 Unrestricted installation: For any *fire separation distance*, an assembly shall be acceptable for installation in accordance with 780 CMR 1406.0 and 780 CMR 1405.0 and 2603.6 if, during the exposure described in 780 CMR 1406.2.1.2, continuous flaming ignition does not occur for a time period greater than five seconds. Continuous flaming ignition shall be judged to occur when continuous flaming is visually observed by laboratory personnel for greater than five seconds.

1406.2.1.3.2 Restricted installation: For *fire separation distances* greater than five feet (1524 mm), an assembly shall be permitted with increased *fire separation distance* if a test specimen in accordance with 780 CMR 1406.2.1.1, while being exposed to a reduced level of incident radiant heat energy in accordance with 780 CMR 1406.2.1.2, meets the conditions of acceptance in 780 CMR 1406.2.1.3.1. The minimum *fire separation distance* required for the assembly shall be determined from Table 1406.2.1.3.2 based on the maximum tolerable level of incident radiant heat energy determined by 780 CMR 1406.2.1.3.2

1406.2.2 Construction requirements: Combustible *exterior wall finish*, other than fireretardant-treated wood complying with 780 CMR 2310.0 for exterior installation, shall not exceed 10% of an exterior wall surface area where the *fire separation distance* is five feet or less. In buildings of Types 1, 2, 3 and 4 construction, all architectural trim which exceeds 40 feet (12192 mm) in height above *grade plane* shall be constructed of approved noncombustible materials and shall be secured to the wall with metal or other approved noncombustible brackets.

Exception: Foam plastics, installed in accordance with 780 CMR 2603.6, as required, shall not be subject to these limitations.

Table 1406.2.1.3.2

MINIMUM FIRE SEPARATION DISTANCE FOR COMBUSTIBLE VENEERS BASED ON MAXIMUM TOLERABLE LEVEL OF INCIDENT RADIANT HEAT ENERGY

Fire Separation Distance (feet)[a]	Tolerable level incident radient heat energy (kW/m^2)	Fire separation distance (feet)[a]	Tolerable level incident radiant heat energy (kW/m^2)
5	12.5	16	5.9
6	11.8	17	5.5
7	11.0	18	5.2
8	10.3	19	4.9
9	9.6	20	4.6
10	8.9	21	4.4
11	8.3	22	4.1
12	7.7	23	3.9
13	7.2	24	3.7
14	6.7	25	3.5
15	6.3		

Note a. one foot = 304.8mm.

1406.2.3 Location: Where combustible *exterior wall finish* is located along the top of exterior walls, such trim shall be completely backed up by the exterior wall and shall not extend over or above the top of exterior walls.

1406.2.4 Firestopping: Continuous *exterior wall finish* constructed of combustible materials shall be *firestopped* as required in 780 CMR 720.0.

1406.3 Combustible half-timbering: In buildings of Types 3 and 4 construction which do not exceed three stories or 40 ft (12192 mm) in *height* above *grade plane*, exterior half-timbering and similar architectural decorations are permitted to be constructed of wood or other equivalent combustible material, provided that such trim is backed up solidly with approved noncombustible materials.

1406.4 Balconies and similar appendages: All balconies, porches, decks and supplemental exterior *stairways* attached to or supported by buildings of Types 1 and 2 construction shall be constructed of approved noncombustible materials. Such appendages attached to or supported by buildings of Types 3, 4 and 5 construction shall be of either noncombustible or combustible construction. Such appendages of combustible construction, other than fireretardant-treated wood, shall afford the fireresistance rating required by Table 602 for floor construction or shall be of Type 4 construction as described in 780 CMR 2304.0 and the aggregate length shall not exceed 50% of the building perimeter on each floor.

Exceptions:

1. Untreated wood is permitted for pickets and rails, or similar guardrail devices which are limited to 42 inches (1067 mm) in height.
2. Balconies and similar appendages on buildings of Types 3, 4 and 5 construction shall be permitted to be of Type 5 construction, and shall not be required to have a fireresistance rating where *sprinkler* protection is extended to these areas.

1406.5 Bay and oriel windows: A bay window is a window that projects beyond the wall line of a building and extends down to the foundation. All bay and *oriel windows* attached to or supported by walls in other than buildings of Type 5 construction, shall be of noncombustible construction and be framed with brackets of steel, concrete or other approved noncombustible materials.

CHAPTER 15

ROOFS AND ROOF STRUCTURES

780 CMR 1501.0 GENERAL

1501.1 Scope: The provisions of 780 CMR 15 shall govern the materials, design, construction and quality of roofs and roof coverings.

1501.2 Applicability: All roofs and roof coverings shall meet either the performance requirements of 780 CMR 1505.0 or the prescriptive requirements of 780 CMR 1507.0.

780 CMR 1502.0 DEFINITIONS

1502.1 General: The following words and terms shall, for the purposes of 780 CMR 15 and as used elsewhere in 780 CMR, have the meanings shown herein.

Penthouse: An enclosed structure above the roof of a building, other than a roof structure or bulkhead, occupying not more than 33⅓% of the roof area (see 780 CMR 1510.3).

Roof: The roof slab or deck with its supporting members, not including vertical supports.

Roof covering: The covering applied to the roof for weather resistance, fireresistance or appearance.

Roof structure: An enclosed structure on or above the roof of any part of a building (see 780 CMR 1510.0).

780 CMR 1503.0 CONSTRUCTION DOCUMENTS

1503.1 General: For all roofs and roof coverings required by 780 CMR, the *construction documents* shall illustrate, describe and clearly delineate the type of roofing system, materials, fastening requirements and flashing requirements which are to be installed.

780 CMR 1504.0 WEATHER PROTECTION

1504.1 General: All roofs shall be covered with approved roof coverings properly secured to the building or structure to resist wind and rain. Roof coverings shall be designed, installed and maintained in accordance with approved manufacturer's installation instructions such that the roof covering shall serve to protect the building or structure.

780 CMR 1505.0 PERFORMANCE REQUIREMENTS

1505.1 Performance requirements: All roofs and roof coverings approved under 780 CMR 1505.0 shall comply with 780 CMR 1505.2 through 1505.5.

1505.2 Wind resistance: All roofs and roof coverings shall be secured in place to the building or structure to withstand the *wind loads* of 780 CMR 1611.0 in accordance with the requirements of 780 CMR 1505.2.1 through 1505.2.3.

1505.2.1 Ballasted systems: All loosely laid ballasted roof coverings shall be designed to resist the wind pressures as determined by 780 CMR 1611.0.

1505.2.2 Low-slope systems other than ballasted: The low-slope roof systems (coverings) described in 780 CMR 1507.3 which are mechanically attached or adhered to the roof deck shall be designed to meet the design *wind load* of 780 CMR 1611.0 and shall be tested in accordance with FM 4450, FM 4470 or UL 580 listed in ***Appendix A***.

1505.2.3 Steep-slope systems: The steep-slope roof coverings described in 780 CMR 1507.2 which are mechanically attached to the roof slab or deck in accordance with 780 CMR 1507.2.1 through 1507.2.9 shall resist the basic wind speeds of Figure 1611.3, adjusted for *building height* above grade and building exposure.

Exception: Asphalt shingles shall be tested in accordance with ASTM D3161 or UL 997 listed in ***Appendix A***.

1505.3 Durability: All roofs and roof coverings shall be of approved materials such that those properties which establish fire classification, wind resistance and weather protection shall be maintained in accordance with 780 CMR 1505.3.1 and 1505.3.2.

1505.3.1 Physical properties: Roof coverings shall demonstrate physical integrity over the working life of the roof based upon 2,000 hours of exposure to accelerated weathering tests conducted in accordance with ASTM E838, G23, G26 or G53 listed in ***Appendix A***. Those roof coverings which are subject to cyclical flexural response due to *wind loads* shall not demonstrate any significant loss of tensile strength for unreinforced membranes or breaking strength for reinforced membranes when tested as herein required.

1505.3.2 Impact resistance: Roof coverings shall resist impact damage based on the results of tests conducted in accordance with ASTM D3746 or D4272, or CGSB 37-GP-52M or FM 4470 listed in ***Appendix A***.

1505.4 Compatibility of materials: All roofs and roof coverings shall be of materials that are compatible with each other and with the building or structure to which the materials are applied.

1505.5 Material specifications and physical characteristics: All materials for roofs and roof coverings shall conform to the applicable standards listed in 780 CMR 15. In the absence of applicable standards or where materials are of questionable suitability, testing by an *approved testing agency* shall be required by the code official to determine the character, quality and limitations of application of the materials.

780 CMR 1506.0 FIRE CLASSIFICATION

1506.1 Classification: Roof covering materials shall be classified in accordance with 780 CMR 1506.1.1 through 1506.1.4 when tested in accordance with ASTM E108 listed in ***Appendix A***.

1506.1.1 Class A roof coverings: Class A roof coverings are those which are effective against severe fire test exposure. Class A roof coverings shall include the following: masonry, concrete, slate, tile, cement-asbestos or assemblies listed and identified as Class A by an *approved testing agency*. Class A roof coverings shall be permitted for use in buildings or structures of all types of construction.

1506.1.2 Class B roof coverings: Class B roof coverings are those which are effective against moderate fire test exposure. Class B roof coverings shall include metal sheets and shingles or assemblies listed and identified as Class B by an *approved testing agency*. Class B roof coverings shall be permitted as the minimum for use in buildings or structures of Type 1 construction.

1506.1.3 Class C roof coverings: Class C roof coverings are those which are effective against light fire test exposure. Class C roof coverings shall include assemblies listed and identified as Class C by an *approved testing agency*. Class C roof coverings shall be permitted as the minimum for use in buildings or structures of Types 2, 3, 4 and 5A construction.

1506.1.4 Nonclassified roof coverings: Nonclassified roof coverings shall not be permitted.

Exceptions:

1. Buildings and structures of Type 5B construction with a *fire separation distance* of not less than 30 feet (9144 mm) from the leading edge of the roof.
2. Occupancies in Use Group R-3 located in detached buildings and accessory buildings thereto which have a *fire separation distance* of not less than six feet (1829 mm) from the leading edge of the roof.

1506.2 Testing: When testing wood shingles and shakes in accordance with ASTM E 108 (including the rain test) and ASTM D2898 listed in ***Appendix A***, the fire tests shall include the intermittent flame test, spread of flame test, burning brand test and flying brand test; additionally, at the conclusion of the rain test, test panels shall be subjected to the intermittent flame test, burning brand test and flying brand test.

1506.3 Fireretardant-treated shingles and shakes: Fireretardant-treated wood shakes and shingles shall be treated by impregnation with chemicals by the full-cell vacuum-pressure process, in accordance with AWPA C1 listed in ***Appendix A***. Each bundle shall have two *labels*: one identifying the manufactured unit and the manufacturer, and the other identifying the classification of the material in accordance with the testing required in 780 CMR 1506.2 (Class B or C), the treating company and the quality control agency

780 CMR 1507.0 PRESCRIPTIVE REQUIREMENTS

1507.1 Prescriptive requirements: The requirements of 780 CMR 1507.2 and 1507.3 shall apply to all roofs and roof coverings unless specifically approved in accordance with 780 CMR 1505.0. Unless otherwise noted, all required underlayment shall be of Type 15 asphalt-saturated felt.

1507.2 Steep-slope roof coverings: Steep-slope roof covering materials and installations shall comply with 780 CMR 1507.2.1 through 1507.2.9. Where there is a possibility of ice forming along the eaves causing a backup of water, an ice shield that consists of at least two layers of underlayment cemented together or of a waterproofing membrane, shall extend from the eave's edge to a point at least 24 inches (610 mm) inside the exterior wall line of the building.

1507.2.1 Asbestos-cement shingles: Asbestos-cement shingles shall conform to ASTM C222 listed in ***Appendix A***. Asbestos-cement shingles shall not be installed on roof slopes below four units vertical in 12 units horizontal (4:12). Single-layer underlayment is required for all roof applications. Asbestos-cement shingles shall be secured to the roof with two fasteners per shingle.

1507.2.2 Asphalt roll roofing: Asphalt roll roofing shall conform to ASTM D224, D249, D371 or D3909 listed in ***Appendix A***. Asphalt roll roofing shall not be installed on roof slopes below one unit vertical in 12 units horizontal (1:12), and shall not be installed on roof slopes below three units vertical in 12 units horizontal (3:12) unless applied parallel to the eaves. Single-layer underlayment is required or all roof slopes. Asphalt roll roofing shall be secured to the roof in accordance with approved manufacturer's installation instructions.

1507.2.3 Asphalt shingles: Asphalt shingles shall conform to ASTM D225 or D3462 listed in ***Appendix A***. Asphalt shingles shall not be installed on roof slopes below two units vertical in 12 units horizontal (2:12). Double-layer underlayment shall be required on roof slopes below four units vertical in 12 units horizontal (4:12). Single-layer underlayment is required on all other roof slopes. Asphalt shingles shall be secured to the roof with not less than four fasteners per strip shingle, or not less than two fasteners per individual shingle. Shingle headlap shall not be less than two inches (51 mm).

1507.2.4 Interlocking clay or cement tile: Interlocking clay or cement tile shall be installed only over solid sheathing or spaced structural sheathing boards. Interlocking clay or cement tile shall not be installed on roof slopes below four units vertical in 12 units horizontal (4:12). Horizontal battens shall be required on roof slopes over seven units vertical in 12 units horizontal (7:12). Single-layer underlayment is required over solid sheathing on all roof slopes. Reinforced underlayment shall be required where spaced sheathing is installed. Regardless of roof slope, the first three tile courses and all tile within three feet (914 mm) of roof edges, changes in roof slope or changes in slope direction, shall be fastened to the roof. For the field of the roof, fastening is not required on roof slopes below five units vertical in 12 units horizontal (5:12); every tile course shall be fastened on roof slopes five units vertical in 12 units horizontal (5:12) to less than 12 units vertical in 12 units horizontal (12:12); and every tile shall be fastened on roof slopes 12 units vertical in 12 units horizontal (12:12) and over. Tile overlap shall be in accordance with approved manufacturer's installation instructions.

1507.2.5 Noninterlocking clay or cement tile: Noninterlocking clay or cement tile shall not be installed on roof slopes below two and one-half units vertical in 12 units horizontal (2½:12). Double-layer underlayment is required on roof slopes below three units vertical in 12 units horizontal (3:12). Single-layer underlayment is required on all other roof slopes. Noninterlocking clay or cement tile shall be secured to the roof with two fasteners per tile. The minimum tile overlap shall be three inches (76 mm).

1507.2.6 Metal shingles: Metal shingles shall not be installed on roof slopes below four units vertical in 12 units horizontal (4:12). Single-layer underlayment is required for all metal shingles other than flat metal shingles on all roof slopes. Metal shingles shall be secured to the roof in accordance with approved manufacturer's installation instructions.

1507.2.7 Slate shingles: Slate shingles shall conform to ASTM C406 listed in ***Appendix A***. Slate shingles shall not be installed on roof slopes below two units vertical in 12 units horizontal (2:12). Double-layer underlayment shall be required on roof slopes below four units vertical in 12 units horizontal (4:12). Single-layer underlayment shall be required on all other roof slopes. Slate shingles shall be secured to the roof with two fasteners per slate. The minimum slate headlap shall be three inches (76 mm).

1507.2.8 Wood shingles: Wood shingles shall be identified by a *label* and subject to a quality control program administered by an *approved agency*. Wood shingles shall not be installed on roof slopes below three units vertical in 12 units horizontal (3:12). A single layer of underlayment is required at eaves, ridges, hips, valleys and all other changes of roof slope or direction. Wood shingles shall be secured to the roof with a maximum of two approved fasteners per shingle. The maximum weather exposures for wood shingles shall be in accordance with Table 1507.2.8.

Table 1507.2.8
MAXIMUM WEATHER EXPOSURES FOR WOOD SHINGLES

Grade	Shingle length (inches)[a]	Exposure (inches) based on slope (units vertical:units horizontal)	
		3:12 to 4:12	4:12 and steeper
No. 1 grade	16	3¾	5
	18	4¼	5½
	24	5¾	7½
No. 2 grade	16	3½	4
	18	4	4½
	24	5½	6½
No. 3 grade	16	3	3½
	18	3½	4
	24	5	5½

Note a. 1 inch = 25.4 mm

1507.2.9 Wood shakes: Wood shakes, other than preservative-treated southern yellow pine taper sawn shakes, shall be identified by a *label* and subject to a quality control program administered by an *approved agency*. Preservative-treated southern yellow pine taper sawn shakes shall be identified by a label and subject to the TFS *Grading Rules for Preservative Treated Southern Yellow Pine Tapersawn Shakes*, listed in ***Appendix A***, administered by an *approved agency*. Wood shakes shall not be installed on roof slopes less than four units vertical in 12 units horizontal (4:12). A single layer of felt interlayment shall be shingled between each course of wood shakes on all roof slopes. Wood shakes shall be secured to the roof with a maximum of two fasteners per shake. The maximum weather exposure shall be 7½ inches (191 mm) for 18-inch-long shakes and ten inches (254 mm) for 24-inch-long shakes.

1507.3 Low -Slope roof coverings: Low slope roof covering materials and installation shall conform to roofing material/roofing system manufacturer's written installation and warranty requirements and otherwise comply with 780 CMR 1507.3.1 through 1507.3.7. In the absence of manufacturer's written installation and warranty requirements, roofs shall have a design slope of a minimum of one-fourth unit vertical in 12 units horizontal (¼:12) for drainage except for coal-tar built-up roofs which shall have a design slope of a minimum one-eighth unit vertical in 12 units horizontal (⅛:12). The attachment of insulation above the roof deck, the weight and distribution of ballast, the fastener type and fastening pattern, and the bitumen or adhesive application utilized in the installation of low-slope roof coverings shall meet the wind resistance requirements of 780 CMR 1505.2.

1507.3.1 Built-up roofing: Built-up roof covering materials shall comply with the standards in Table 1507.3.1. Provisions shall be made at deck edges, terminations and penetrations for mechanical fastening of the built-up roof covering and flashing materials. On slopes greater than two units vertical in 12 units horizontal (2:12), provisions shall be made for blind nailing the built-up roof covering to the roof to prevent slipping. Aggregate surfacing shall not be installed, and plies shall be applied parallel to the slope of the deck (strapping method) on roof slopes above three units vertical in 12 units horizontal (3:12). Built-up roof coverings shall be installed in accordance with approved manufacturer's installation instructions.

Table 1507.3.1
BUILT-UP ROOFING MATERIAL STANDARDS

Material	Standard[a]
Aggregate surfacing	ASTM D1863
Asphalt-coated glass fiber venting base sheet	ASTM D4601
Asphalt glass felt	ASTM D2178
Asphalt-saturated and asphalt-coated organic felt base sheet	ASTM D2626
Asphalt-saturated organic felt (perforated)	ASTM D226
Asphalt used in roofing	ASTM D312
Coal-tar saturated organic felt	ASTM D227
Coal-tar used in roofing	ASTM D450 Types I or III
Mineral-surfaced inorganic cap sheet	ASTM D3909
Venting, asphalt-saturated and asphalt-coated inorganic felt based sheet	ASTM D3672

Note a. Specific standards referenced are those listed in *Appendix A*

1507.3.2 Thermoset single-ply roof coverings: Thermoset single-ply roof coverings shall comply with RMA RP-I, RP-2 or RP-3, or ASTM D4637 or CGSB 37-GP-52M listed in ***Appendix A***. Provisions shall be made at deck edges, terminations and penetrations for mechanical fastening of the thermoset single-ply roof covering and flashing materials. Ballasted roof coverings shall not be installed on roof slopes above two units vertical in 12 units horizontal (2:12). Thermoset single-ply roof coverings shall be installed in accordance with approved manufacturer's installation instructions.

1507.3.3 Thermoplastic single-ply roof coverings: Thermoplastic single-ply roof coverings shall comply with ASTM D4434 or CGSB 37-GP-54M listed in ***Appendix A***. Provisions shall be made at deck edges, terminations and penetrations for mechanical fastening of the thermoplastic single-ply roof covering and flashing materials. Ballasted roof coverings shall not be installed on roof slopes above two units vertical in 12 units horizontal (2:12). Thermoplastic single-ply roof coverings shall be installed in accordance with approved manufacturer's installation instructions.

1507.3.4 Modified bitumen roof coverings: Modified bitumen roof coverings shall comply with CGSB 37-GP-56M listed in ***Appendix A***. Provisions shall be made at deck edges, terminations and penetrations for mechanical fastening of the modified bitumen roof covering and flashing materials. Modified bitumen roof coverings shall be installed in accordance with approved manufacturer's installation instructions.

1507.3.5 Spray-applied polyurethane-foam roof covering systems: Spray-applied polyurethane-foam insulation shall comply with ASTM C1029 listed in ***Appendix A***. A liquid-applied roof coating that complies with 780 CMR 1507.3.6 shall be applied to the top surface of the cured foam insulation in accordance with approved manufacturer's installation instructions. Foam plastics shall also conform to 780 CMR 2603.0.

1507.3.6 Liquid-applied roof coatings: Liquid-applied roof coatings shall comply with ASTM C836, C957, D1227 or D3468 listed in ***Appendix A***. Liquid-applied roof coatings shall be applied in accordance with approved manufacturer's installation instructions.

1507.3.7 Metal-sheet roof coverings: Metal-sheet roof covering systems which incorporate supporting structural members shall be designed in accordance with 780 CMR 2206.0. Metal-sheet roof coverings installed over structural decking shall comply with ASTM A361, A755 or B101 listed in ***Appendix A***. Metal-sheet roof coverings shall be installed in accordance with approved manufacturer's installation instructions.

780 CMR 1508.0 FLASHINGS

1508.1 General: Flashings shall be installed: at wall and roof intersections; at gutters; wherever there is a a change in roof slope or direction: and around all roof openings.

780 CMR 1509.0 ROOF INSULATION

1509.1 General: Rigid combustible roof insulation shall be permitted, provided that the insulation is covered with approved roof coverings directly applied thereto (see 780 CMR 2603.4.1.5).

780 CMR 1510.0 ROOF STRUCTURES

1510.1 General: All construction, other than aerial supports, clothes dryers and similar structures less than 12 feet (3658 mm) high, water tanks and cooling towers as hereinafter provided and flag poles erected above the roof of any part of any building or structure more than 40 feet (12192 mm) in *height*, shall be constructed of approved noncombustible materials.

1510.2 Scuttles: Trap doors and scuttles as required by 780 CMR 1027.0 shall not be less than two feet by three feet (610 mm by 914 mm) in size. In buildings of Types 1 and 2 construction, trap doors and scuttles shall be of approved noncombustible materials.

1510.3 Penthouses: *Penthouses* shall be considered a part of the next lower story, and the enclosure shall conform to the requirements for exterior walls of the building type as regulated by Table 602 and 780 CMR 14 except as modified herein.

1510.3.1 Recessed walls: Where the exterior wall of a *penthouse* is recessed five feet (1524 mm) or more from the exterior wall of the next lower story and the exterior wall of the next lower story is required to have a fireresistance rating of greater than 1½ hours, the *penthouse* exterior wall shall be: constructed with a fireresistance rating of not less than 1½ hours; covered on the outside with noncombustible, weatherproof material; and supported on *protected* steel or reinforced concrete construction.

1510.3.2 Unprotected openings: Where *protected* openings are not required by 780 CMR 705.0, windows and doors shall be constructed of any approved materials. Glazing shall conform to the requirements of 780 CMR 14, 24 and 26.

1510.4 Other enclosed roof structures: Enclosed roof structures, other than *penthouses*, shall be considered a story of the building and shall conform to the requirements for the building type as regulated by Table 602 and 780 CMR 14.

1510.5 Mansards and other sloping roofs: Mansards and other sloping roofs shall comply with 780 CMR 1510.5.1 and 1510.5.2.

1510.5.1 High-slope roofs: Every mansard roof or other sloping roof having a pitch of more than 60 degrees (1.05 rad) to the horizontal hereafter erected on any building or structure of other than Type 5 construction which is more than three stories or 40 feet (12192 mm) in *height*, shall be constructed of noncombustible materials with a fireresistance rating of not less than one hour. Where the building is more than seven stories or 85 feet (25908 mm) in *height*, such roofs shall afford the same fireresistance rating required for the exterior walls of the building, but are not required to exceed a 1½-hour fireresistance rating.

1510.5.2 Low-slope roofs: Where the pitch is 60 degrees (1.05 rad) or less to the horizontal, the mansard or other sloping roof located on any building shall be constructed of not less than the same materials as required for the roof of the building.

1510.6 Dormers: The sides and roofs of dormers shall be of the same type of construction as the main roof, except that where a side of the dormer is a vertical extension of an exterior wall, that side of the dormer shall be subject to the same fireresistance rating requirements as apply to the wall of the building. The roofs of dormers shall be protected with approved roof coverings complying with 780 CMR 1506.0. The sides of dormers shall be protected with approved roof coverings or with material permitted for covering the exterior walls of the building.

1510.7 Water tanks: Water tanks shall be constructed and installed in accordance with 780 CMR 1510.7.1 through 1510.7.5.

1510.7.1 Supports: Water tanks having a capacity of more than 500 gallons (1.90 m^3) placed in or on a building shall be supported on masonry, reinforced concrete, steel or other approved noncombustible framing or on timber conforming to Type 4 construction; provided that, where such supports are located in the building above the lowest story, the support shall be fireresistance rated as required for Type 1A construction.

1510.7.2 Emergency discharge: A pipe or outlet shall be located in the bottom or in the side close to the bottom, or the tank shall be fitted with a quick-opening valve, to enable the contents to be discharged in an emergency to a suitable drain that complies with the ***248 CMR 2.00: the Massachusetts State Plumbing Code*** listed in ***Appendix A***.

1510.7.3 Location: A tank shall not be located over or near a *stairway* or elevator *shaft* unless a solid roof or floor deck is constructed underneath the tank.

1510.7.4 Tank cover: All roof tanks exposed to the weather shall have approved covers sloping towards the outer edges.

1510.7.5 Hoop and strap protection: Where metal hoops are utilized in the construction of wood tanks, such hoops shall be protected with approved corrosion-resistant coatings or manufactured from approved corrosion-resistant alloys.

1510.8 Cooling towers: Cooling towers erected on the roofs of buildings where the base of the tower is more than 55 feet (16764 mm) above *grade plane* shall be constructed of approved noncombustible material or fireretardant-treated wood except that drip bars are not required to be of noncombustible material or fireretardant-treated wood

1510.9 Miscellaneous roof structures: Except as here in specifically provided for, all towers, spires, dormers or cupolas shall be erected of the type of construction and fireresistance rating required for the building to which such structures are accessory as regulated by Tables 503 and 602. Where the *height* of such *appurtenant structures* exceeds 85 feet (25908 mm) above *grade plane* or where the area at any horizontal section of the tower, spire, dormer or cupola exceeds 200 square feet (19 m^2), or where utilized for any purpose other than as a belfry or architectural embellishment, the structure and the associated supports shall be of Type 1 or 2 construction, or of fireretardant-treated wood complying with 780 CMR 2310.0. Radio and television towers and antennas shall be constructed to comply with 780 CMR 3108.0 and 3109.0.

780 CMR 1511.0 ROOFTOP HELIPORTS

1511.1 General: 780 CMR 1511.0 governs the design and construction of rooftop facilities intended to accommodate the landing of helicopters. The utilization of a roof for landing shall be subject to the approval of the Federal Aviation Administration.

1511.2 Structural loads: The roof and all pertinent building components shall be designed for the *dead loads*, *live loads*, *impact loads* and vibrations imparted to the structure due to helicopter landing, including the single-skid point landing.

1511.3 Referenced standard: All rooftop heliports shall comply with NFiPA 418 listed in ***Appendix A***.

780 CMR 1512.0 REROOFING

1512.1 General: Materials and methods of application used for recovering or replacing an existing roof covering shall comply with the requirements of 780 CMR 1505.0 or 1507.0. The repair of existing roofs and roof coverings shall comply with the provisions of 780 CMR 34, but more than 25% of the roof covering of any building shall not be removed and replaced within any 12-month period unless the entire roof covering is made to conform to the requirements for new roofing.

1512.2 Structural and construction loads: The structural roof components shall be capable of supporting the roof covering system and the material and equipment *loads* that will be encountered during installation of the roof covering system.

1512.3 Recovering vs. replacement: New roof coverings shall not be installed without first removing existing roof coverings where any of the following conditions occur:

1. Where the existing roof or roof covering is water soaked or has deteriorated to the point that the existing roof or roof covering is not adequate as a base for additional roofing.
2. Where the existing roof covering is wood shake, slate, clay, cement or asbestos-cement tile.
3. Where the existing roof has two or more applications of any type of roof covering.

> **Exception**: Complete and separate roofing systems, such as standing-seam metal roof systems, which are designed to transmit all roof *loads* directly to the building's structural system and which do not rely on existing roofs and roof coverings for support, shall not require the removal of existing roof coverings.

1512.4 Reinstallation of materials: Existing slate, clay or cement tile shall be permitted for reinstallation, except that damaged, cracked or broken slate or tile shall not be reinstalled. Existing vent flashings, metal edgings, drain outlets, collars and metal counterflashings shall not be reinstalled where rusted, damaged or deteriorated. Aggregate surfacing materials shall not be reinstalled.

1512.5 Flashings: Flashings shall be reconstructed in accordance with approved manufacturer's installation instructions. Metal flashings to which bituminous materials are to be adhered shall be primed prior to installation.

CHAPTER 16

STRUCTURAL LOADS

(This Chapter is entirely unique to Massachusetts)

780 CMR 1601.0 GENERAL

1601.1 Scope: The provisions of 780 CMR 16 shall control the structural design of all buildings and structures, or portions thereof, hereafter erected.

780 CMR 1602.0 DEFINITIONS

1602.1 General: The following words and terms shall, for the purposes of 780 CMR 16 and as used elsewhere in 780 CMR, have the meanings shown herein.

Load: Forces or other actions that arise on structural systems from the weight of all permanent construction, occupants and their possessions, environmental effects, differential settlement and restrained dimensional changes.

Dead load: The weight of all permanent structural and nonstructural components of a building, such as walls, floors, roofs, ceilings, *stairways* and fixed service equipment.

Duration of load: The period of continuous application of a given *load*, or the aggregate of periods of intermittent applications of the same *load*.

Earthquake load: The assumed lateral *load* acting in any horizontal direction on the structural frame due to the dynamic action of earthquakes.

Impact load: The *load* resulting from moving machinery, elevators, craneways, vehicles and other similar forces and kinetic *loads*.

Internal load: The forces resulting from the restraint of movement of construction materials or differential movement of a combination of materials caused by the effects of expansion or contraction due to temperature changes, shrinkage, moisture changes, creep, differential settlement or combinations thereof.

Lateral soil load: The lateral pressure in pounds per square foot (psf) (kilograms per square meter [kg/m^2]) due to the weight of the adjacent soil, including due allowance for hydrostatic pressure and possible surcharge from fixed or moving *loads*.

Live load: Those *loads* produced by the occupancy of the building, not including environmental *loads* such as *wind loads*, snow *loads*, *earthquake loads* or *dead loads*.

Wind load: The lateral pressure on the building or structure in pounds per square foot (psf) (kilograms per square meter [kg/m^2]) due to wind blowing in any direction.

Panel (part of a structure): The section of a floor or wall comprised between the supporting frame of two adjacent rows of columns and girders or column bands of floor construction.

Wall

Loadbearing wall: A wall supporting any vertical load in addition to its own weight.

Nonloadbearing wall: A wall which does not support vertical *loads* other than its own weight.

780 CMR 1603.0 CONSTRUCTION DOCUMENTS

1603.1 General: *Construction documents* shall show the size, and relative locations of all structural members with foundation, floor and roof levels, column centers and all offsets dimensioned. The design loads and other information pertinent to the structural design required by 780 CMR 1603.2 through 1603.7 shall be clearly indicated on the *construction documents* for all parts of the building or structure.

1603.2 Floor live load: The uniformly distributed floor *live load* utilized in the design shall be indicated for all floor areas (780 CMR1606.0). *Live load* reduction (780 CMR 1608.0), if utilized, shall be indicated.

1603.3 Roof live load: The roof *live load* utilized in the design shall be indicated for all roof areas (780 CMR 1609.0).

1603.4 Roof snow load: The basic snow *load* shall be indicated.

1603.5 Wind load: The following information related to *wind loads* shall be indicated, regardless of whether *wind loads* govern the lateral design of the building:

1. Wind Load Zone. If more than one wind direction is exposed, the applicable wind direction shall be indicated
2. Wind pressure, P.
3. Special exposures

1603.6 Earthquake design data: Where *earthquake loads* are applicable, the following earthquake design data shall be indicated on the *construction documents*:

1. The Seismic Hazard Exposure Group in accordance with 780 CMR 1612.2.5;
2. The Seismic Performance Category in accordance with 780 CMR 1612.2.7;

3. The soil-profile type in accordance with Table 1612.4.1;
4. The basic structural system and seismic-resisting system in accordance with Table 1612.4.4;
5. The response modification factor (R) and the deflection amplification factor (C_d) in accordance with Table 1612.4.4; and
6. The analysis procedure utilized in accordance with 780 CMR 1612.5 or 1612.6 as applicable.

1603.7 Other loads: Concentrated *loads* (780 CMR 1613.0), *impact loads* (780 CMR 1614.0) and special *loads* (780 CMR 1615.0) which are applicable to the design of the building or structure shall he indicated.

780 CMR 1604.0 DESIGN SAFE LOAD

1604.1 Safe support required: Buildings or other structures, and all parts thereof, shall be designed and constructed to support safely all *loads*, including *dead loads*, without exceeding the allowable stresses (or specified strengths when appropriate *load* factors are applied) for the materials of construction in the structural members and connections.

1604.2 Progressive collapse: Buildings and structural systems shall provide such structural integrity that the hazards associated with progressive collapse are reduced to a level consistent with good engineering practice. Structures shall be able to sustain local damage or failure, with the structure as a whole remaining stable. Compliance with the applicable provisions of ASCE 7 listed in ***Appendix A*** shall be deemed to meet the requirements of 780 CMR 1604.0.

1604.3 In-situ load tests: The code official is authorized to require an engineering analysis or a load test, or both, of any construction whenever there is reason to question the safety of the construction for the intended occupancy. Engineering analysis and load tests shall be conducted in accordance with 780 CMR 1707.0 or 1709.0.

780 CMR 1605.0 DESIGN DEAD LOAD

1605.1 Weights of materials and construction: In estimating *dead loads* for the purposes of structural design, the actual weights of materials and constructions shall be utilized, but not less than the unit *dead loads* prescribed in Appendix G, or ASCE 7 listed in ***Appendix A***. In the absence of definite information, any values assumed by the designers shall be subject to the approval of the code official.

1605.2 Weight of fixed service equipment: In estimating *dead loads* for the purposes of design, the weight of fixed service equipment such as plumbing stacks and risers, electrical feeders, heating, *ventilating*, air conditioning and *fire protection systems*, shall be included.

1605.3 Partition load: In offices and other buildings in which subdividing partitions are subsequently erected, rearranged or relocated, provisions shall be made to support the actual weight of such partitions where the partitions occur, or for an equivalent uniform *load*, which shall be assumed to be not less than 20 psf (97.64 kg/m^2) of floor area in addition to the specified uniformly distributed *live load*. Provisions for partition weight shall be made whether or not partitions are shown on the *construction documents*, unless the specified *live load* exceeds 80 psf (390.56 kg/m^2).

780 CMR 1606.0 UNIFORMLY DISTRIBUTED LIVE LOADS

1606.1 Uniform live load: The minimum uniformly distributed *live load* in pounds per square foot shall be as provided for in Table 1606.1, and for all concentrated *loads* wherever such *loads* occur as provided for in 780 CMR 1613.0. The *live loads* in Table 1606.1 are the minimum *loads* to be used for the occupancies listed. Where the building will be subjected to greater *live loads*, such *loads* shall be utilized for design.

1606.1.1 Trucks and buses: Minimum *live loads* for *garages* having trucks or buses shall be in accordance with lane *loads* of AASHTO HB- 15 listed in ***Appendix A***, but shall not be less than 50 psf (244 kg/m^2).

1606.1.2 Residential attics: All *live load* shall be applied to joists or to bottom chords of trusses or trussed rafters only in those portions of *attic* space having a clear height of 42 inches (1067 mm) or more between joist and rafter in conventional rafter construction; and between bottom chord and any other member in trusses or trussed rafter construction. However, joists or the bottom chords of trusses or trussed rafters shall be designed to sustain the imposed *dead load* or ten psf (49 kg/m^2), whichever is greater, uniformly distributed over the entire span.

A further ceiling dead-load reduction to a minimum of five psf (24 kg/m^2) or the actual *dead load*, whichever is greater, applied to joists in conventional rafter construction or to the bottom chords of trusses or trussed rafters is permitted under either or both of the following conditions:

1. Where the clear height is not over 30 inches (762 mm) between joist and rafter in conventional construction and between the bottom chord and any other member for trusses or trussed rafter construction.
2. Where a clear height of greater than 30 inches (762 mm), as defined in 780 CMR 1606.1 item 1, does not exist for a horizontal distance of more than 12 inches (305 mm) along the member.

Table 1606.1
MINIMUM UNIFORMLY DISTRIBUTED LIVE LOADS

Occupancy	Live load (psf)[a]
Apartments (see Residential)	
Armories and drill rooms	150
Assembly areas & theatres:	
Fixed seats	60
Movable seats	100
Platforms (assembly)	100
Stage floors	150
Balcony, decks (exterior)	100
One-and two-family dwellings only	60
Bowling centers, poolrooms and billiard rooms	75
Cornices	60
Corridors, except as otherwise indicated	100
Dwellings (see Residential)	
Fire escapes	100
Single-family residential buildings only	40
Garages:	
Passenger cars	50
Trucks and buses - see also 780 CMR 1606.1.1	50
Grandstands (see Reviewing stands)	
Gymnasiums, main floors and balconies	100
Hospitals	
Operating Rooms Laboratories	100
Private Rooms	40
Wards	40
Corridors above first floor	80
Hotels (see Residential)	
Institutional - residential care (see Residential)	
Libraries:	
Reading Rooms	60
Stack rooms (books and shelves @ 40 pcf but not less than)	150
Manufacturing	
Light	125
Heavy	150
Marquees	75
Office buildings:	
Offices	50
Lobbies	100
Corridors, above first floor	80
File and computer rooms require heavier *loads* based upon anticipated occupancy	
Penal Institutions:	
Cell Blocks	40
Corridors	100
Residential:	
Attics - see 780 CMR 1606.1.2	20
Multiple - family dwellings:	
Dwelling units	40
Public rooms	100
Corridors	80
One-and two-family dwellings (areas other than sleeping rooms)	40
Sleeping rooms	30
Decks, balconies, etc.	60
Hotels:	
Guestrooms	40
Public rooms	100
Corridors serving public rooms	100
Corridors	80
Reviewing stands, grandstands and bleachers - see 780 CMR 1615.5	100
Schools	
Classrooms	50
Corridors	80
Flexible open plan areas	100
Sidewalks, vehicular driveways, subject to trucking	250
Skating rinks	100
Stairs and exits	100
Storage areas:	
Light	125
Heavy	250
Stores:	
Retail - 1st floor	100
Retail - upper flloors	75
Wholesale	100
Yards and terraces, pedestrians	100

Note a. 1 psf = 4.882 kg/m^2.

780 CMR 1607.0 DESIGN LIVE LOAD

1607.1 Required live load: The *live loads* to be assumed in the design of buildings and structures shall be the greatest *load* produced by the intended occupancy, but not less than the minimum uniformly distributed unit *loads* required in 780 CMR 1606.0 for specific use groups.

1607.2 Loads not specified: The code official shall approve the required *live load* for any occupancy not specifically provided for in Table 1606.1.

1607.3 Partial loading: The full intensity of the appropriately reduced live load applied only to a portion of the length of a structure or member shall be considered if such applied load produces a more unfavorable effect than the same intensity applied over the full length of the structure or member.

780 CMR 1608.0 LIVE LOAD REDUCTION

1608.1 General: The design live loads specified in 780 CMR 1607.0 may be reduced as permitted and specified herein, except that the design live load shall not be reduced on the following types of structural members:

1. One-way precast or cast-in-place solid, ribbed and hollow core concrete slabs.

   Exception: Ribs of ribbed or hollow core slabs may be treated as individual beams, and live load may be reduced on the ribs the same as for beams.

2. Two-way concrete flat slabs and grid slabs, with or without capitals or drop panels.

   Exception: live load may be reducted on slab panels if there are beams on all sides of the panels, and load is transferred to the columns from these beams entirely by “beam shear”.

3. Hangers

1608.2 Design live loads of 100 psf or less: Except for places of public assembly (as defined in 780 CMR 210.) garages, and open parking structures, a structural member having a tributary area A_T that is greater than A_B may be designed for a reduced live load determined by the following formulas:

$$L = NL_O$$

N = the largest of the following:
1. $1 - 0.0008\ (A_T - A_B)$
2. $0.75 - 0.20\ (D_o/L_o)$
3. 0.50 for members supporting load from more than one floor, or 0.60 for members supporting load from one floor only, in which:

L = reduced design live load for the member

L_o = basic design live load

D_o = dead load on the member

A_T = loaded area tributary to the member, square feet

A_B = basic tributary area, square feet, defined as follows:

A_B = 100 square feet for members supporting load from more than one floor

A_B = 250 square feet for members supporting load from one floor only

1608.3 Design live loads greater than 100 psf and design live loads for garages and open parking structures: Structrual members supporting load from more than one floor may be designed for a reduced live load equal to 80% of the design live load.

1608.4 For determination of the number of floors supported by a member in 780 CMR 1608.1, 1608.2 and 1608.3 a roof may be considered to be a floor if the design live load of the roof is equal to or greater than the design live load of the floor below.

780 CMR 1609.0 ROOF LOADS

1609.1 General: The structural supports of roofs and marquees shall be designed to resist *wind* (see 780 CMR 1611.0) and, where applicable, snow (see 780 CMR 1610.0) and *earthquake loads* (see 780 CMR 1612.0) in addition to the *dead load* of construction and the appropriate *live loads* as prescribed in 780 CMR 1609.0, or in Table1606.1

1609.2 Definitions: The following words and terms shall, for the purposes of 780 CMR 1609.0 and as used elsewhere in 780 CMR, have the meanings shown herein.

Fabric awning: A fabric awning is an architectural projection that provides weather protection, identity or decoration and is wholly supported by the building to which it is attached. An awning is comprised of a lightweight, rigid or retractable skeleton structure over which a fabric cover is attached.

Fabric canopy: A fabric canopy is an architectural projection that provides weather protection, identity or decoration and is ground supported in addition to being supported by the building to which the canopy is attached. A canopy is comprised of a lightweight skeleton structure over which a fabric cover is attached. A fabric canopy is not a primary structure or a roof.

1609.3 Minimum roof loads: Ordinary roofs, either flat, pitched or curved, shall be designed for the *live loads* as specified in Table 1609.3 or the snow *load*, whichever is greater.

1609.4 Overhanging eaves: In other than occupancies in Use Group R-3, and except where the overhang framing is a continuation of the roof framing, overhanging eaves, cornices and other roof projections shall be designed for a minimum uniformly distributed *live load* of 60 psf (292.92 kg/m^2).

Table 1609.3
MINIMUM ROOF LIVE LOADS[a]

Roof slope	Tributary loaded area in square feet[b] for any structural member		
	0 to 200	201 to 600	Over 600
Flat, or rise less than 4 inches per foot (1:3) Arch or dome with rise less than ⅛ of span	20	16	12
Rise 4 inches per foot (1:3) to less than 12 inches per foot (1:1) Arch or dome with rise ⅛ of span or less than ⅜ of span	16	14	12
Rise 12 inches per foot (1:1) and greater Arch or dome with rise ⅜ of span or greater	12	12	12

Note a: *loads* are expressed in pounds per square foot of horizontal projection

Note b: 1 square foot = 0.093 m^{2}, 1 psf = 4.882 kg/m^2

1609.5 Ponding: Roofs shall be designed for the maximum possible depth of water that would pond thereon as determined by the relative levels of roof deck and overflow weirs, scuppers, edges or serviceable drains in combination with the deflected structural elements. In determining the maximum possible depth of water, all primary roof drainage means shall be assumed to be blocked.

1609.6 Special purpose roofs: Where occupied for incidental promenade purposes, roofs shall be designed for a minimum *live load* of 60 psf (292.92 kg/m^2); and 100 psf (488.20 kg/m^2) where designed for roof gardens or assembly or educational occupancies.

1609.6.1 Landscaped roofs: Where roofs are to be landscaped, the uniform design *live load* in the landscaped area shall be 20 psf (97.64 kg/m^2). The weight of the landscaping materials shall be considered as *dead load* and shall be computed on the basis of saturation of the soil.

1609.6.2 Fabric awnings and canopies: Where awnings and canopies are covered with a *fabric* material, such awnings and canopies shall be designed for a uniform *live load* of 5 psf (24.4 kg/m^2) as well as for snow *loads* and *wind loads* as specified in 780 CMR 1610.0 and 1611.0.

1609.6.3 Special purpose roofs: Roofs to be utilized for other special purposes shall be designed for appropriate *loads*, or as otherwise approved.

780 CMR 1610.0 SNOW LOADS

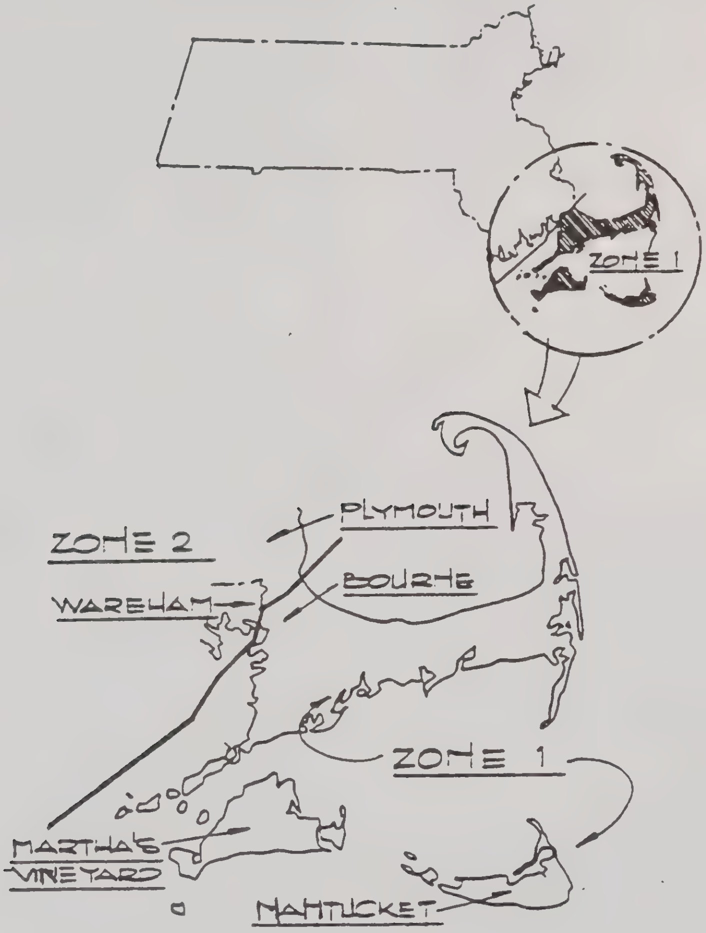
1610.1 General: Design snow *loads* shall be determined in accordance with 780 CMR 1610.0 and shall be applied to the roof and open decks of all buildings and other structures.

1610.1.1 Application of loads: Buildings and other structures shall be designed for the greater of the effects from either a uniform snow load over the whole roof or open deck (balanced snow load) or an unbalanced snow load on the roof or open deck (partial snow load). Buildings and other structures shall also be designed for the additional effects of drifting snow at changes in roof elevation and at roof projections, and for the additional effects of sliding snow. Snow loads acting on a sloping surface shall be considered to act on the horizontal projection of that surface. When establishing unbalanced snow loads or drifting snow loads, the effects of wind from any direction shall be considered.

1610.2 Basic snow load: Figures 1610.1A, 1610.1B, 1610.1C, and 1610.1D define four snow load zones in the state. The basic snow load for each zone shall be a uniformly distributed load, P_f, in pounds per square foot of horizontal projection, as follows:

Snow Load Zone	P_f
1	25 psf
2	30 psf
3	35 psf
4	40 psf

Figure 1610.1A
SNOW LOAD MAP - ZONE 1


ZONE 1
PLYMOUTH
ZONE 2
BOURNE
WAREHAM
ZONE 1
MARTHA'S VINEYARD
NANTUCKET

List of Towns in Minimum Uniform
Snow Load Zones Zone 1

Barnstable
Bourne
Brewster

Chatham
Chilmark

Dennis

Eastham
Edgartown

Falmouth

Gay Head
Gosnold

Harwich

Mashpee

Nantucket

Oak Bluffs
Orleans

Provincetown

Sandwich

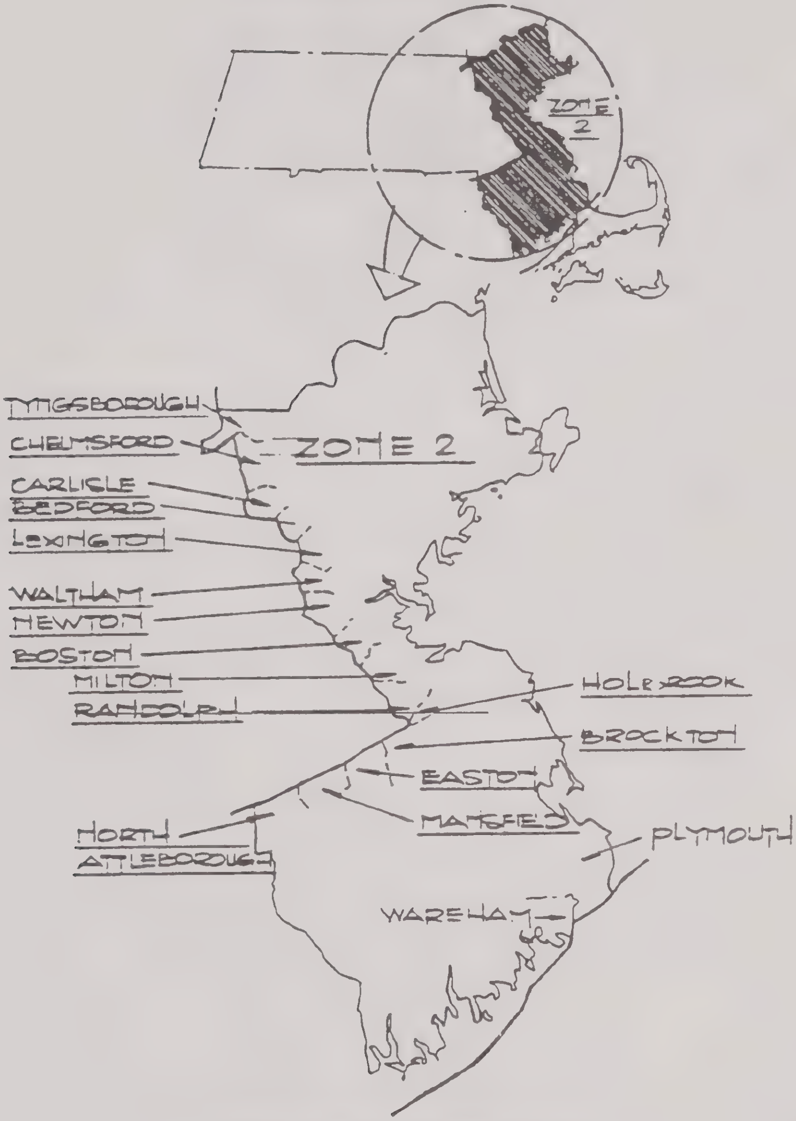
Tisbury
Truro

Vineyard Haven

Wellfleet
West Tisbury

Yarmouth

Figure 1610.1B
SNOW LOAD MAP - ZONE 2


ZONE 2
TYNGSBOROUGH
CHELMSFORD
ZONE 2
CARLISLE
BEDFORD
LEXINGTON
WALTHAM
NEWTON
BOSTON
MILTON
RANDOLPH
HOLBROOK
BROCKTON
EASTON
MANSFIELD
PLYMOUTH
NORTH ATTLEBOROUGH
WAREHAM

List of Towns in Minimum Uniform
Snow Load Zones Zone 2

Abington
Acushnet
Amesbury
Andover
Arlington
Attleboro

Bedford
Belmont
Berkley
Beverly
Billerica
Boston
Boxford
Braintree
Bridgewater
Brockton
Brookline
Burlington

Cambridge
Carlisle
Carver
Chemlsford
Chelsea
Cohasset

Danvers
Dartmouth
Dighton
Dracut
Duxbury

E. Bridgewater
Easton
Essex
Everett

Fairhaven
Fall River

Freetown

Georgetown
Gloucester
Groveland

Halifax
Hamilton
Hanover
Hanson
Haverhill
Hingham
Holbrook
Hull

Ipswich

Kingston

Lakeville

Lawrence
Lexington
Lowell
Lynn
Lynnfield

Malden
Manchester
Mansfield
Marblehead
Marion
Marshfield
Mattapoisett
Medford
Melrose
Merrimac
Methuen
Middleborough
Middleton

Milton

Nahant
New Bedford
Newbury
Newburyport
Newton
N. Andover
N. Attleboro
N. Reading
Norton
Norwell

Peabody
Pembroke
Plymouth
Plympton

Quincy

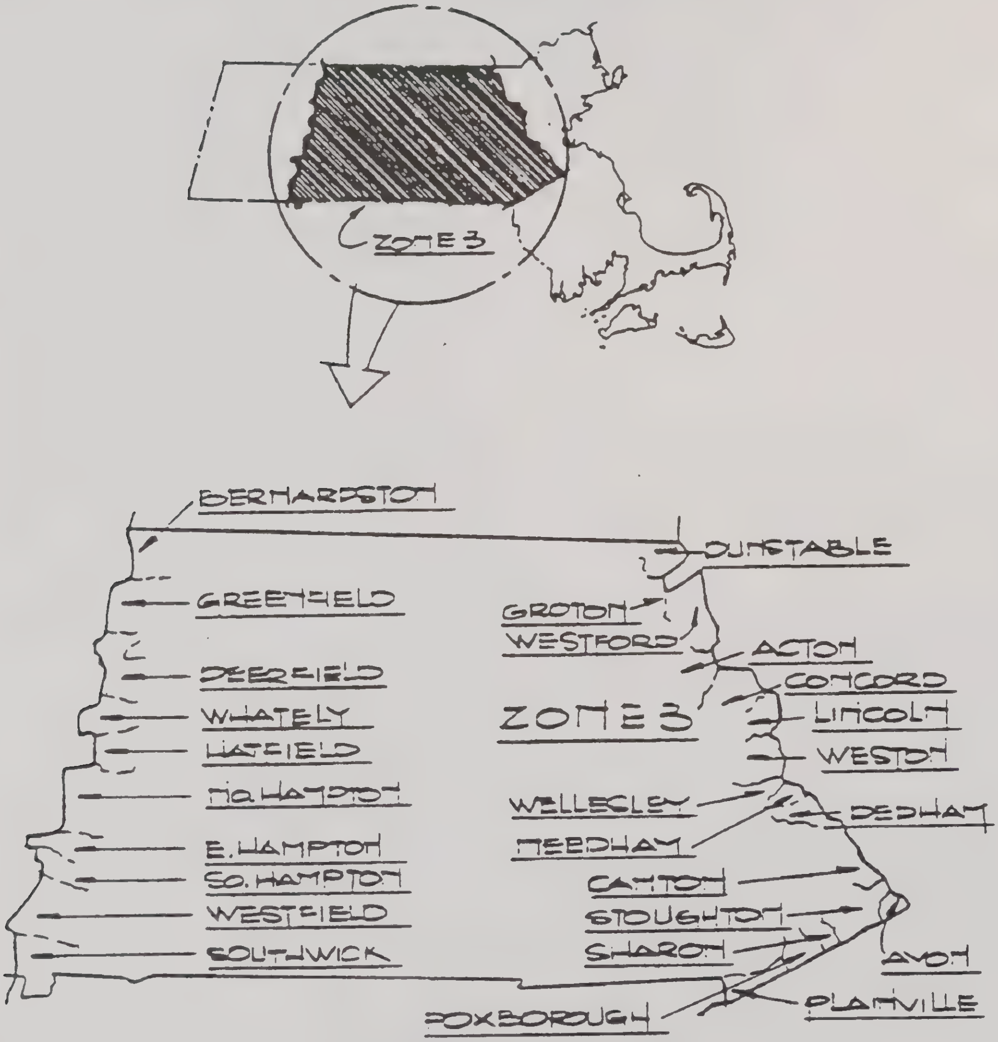
Randolph
Raynham
Reading
Rehoboth
Revere
Rochester
Rockland
Rockport
Rowley

Salem
Salisbury
Saugus
Scituate
Seekonk
Somerset
Somerville
Stoneham
Swampscott
Swansea

Taunton
Tewksbury
Topsfield
Tyngsborough

Wakefield
Waltham
Wareham
Watertown
Wenham
W. Bridgewater
W. Newbury
Westport
Weymouth
Whitman
Wilmington
Winchester
Winthrop
Woburn

Figure 1610.1C
SNOW LOAD MAP - ZONE 3


ZONE 3
BERNARDSTON
DUNSTABLE
GREENFIELD
GROTON
WESTFORD
ACTON
DEERFIELD
CONCORD
WHATELY
ZONE 3
LINCOLN
HATFIELD
WESTON
NO. HAMPTON
WELLESLEY
DEDHAM
NEEDHAM
E. HAMPTON
SO. HAMPTON
CANTON
WESTFIELD
STOUGHTON
SOUTHWICK
SHARON
AVON
PLAINVILLE
FOXBOROUGH

List of Towns in Minimum Uniform Snow Load Zones Zone 3

Acton
Agawam
Amherst
Ashburnham
Ashby
Ashland
Athol
Auburn
Avon
Ayer

Barre
Belchertown
Bellingham
Berlin
Bernardston
Blackstone
Bolton
Boylston
Boxborough
Brimfield
Brookfield

Canton
Charlton
Chicopee
Clinton
Concord

Dedham
Deerfield
Douglas
Dover
Dudley
Dunstable

E. Brookfield
Easthampton
E. Longmeadow
Erving

Fitchburg
Foxborough
Framingham
Franklin

Gardner
Gill
Grafton
Granby
Greenfield
Groton

Hadley
Hampden
Hardwick
Harvard
Hatfield
Holland
Holliston
Holden
Holyoke
Hopedale
Hopkinton
Hubbardston
Hudson

Lancaster
Leicester
Leominster
Leverett
Lincoln
Littleton
Longmeadow
Ludlow
Lunenburg

Marlborough
Maynard
Medfield
Millbury
Millville
Medway
Mendon
Milford
Millis
Monson
Montague

Natick
Needham
New Braintree
New Salem
Norfolk
North Brookfield
Northampton
Northborough
Northbridge
Northfield
Norwood
Oakham
Orange
Oxford

Palmer
Paxton
Pelham
Pepperell
Petersham
Phillipston
Plainville
Princeton

Royalston
Rutland

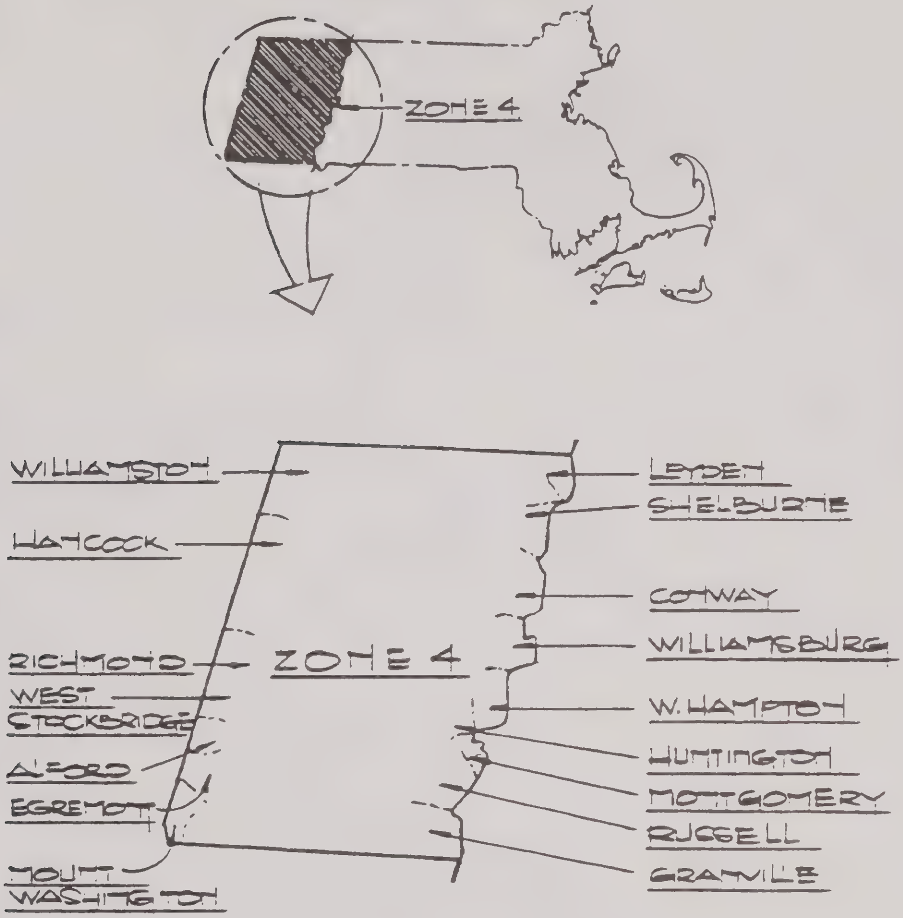
Southbridge
Southwick
Spencer
Springfield
Sterling
Stoughton
Stow
Sturbridge
Sudbury
Sunderland
Suttton
Sharon
Sherborn
Shirley
Shrewsbury
Shutesbury
S. Hadley
Southampton
Southborough

Templeton
Townsend

Upton
Uxbridge

Wales
Walpole
Ware
Warren
Warwick
Wayland
Webster
Wellesley
Wendell
West Boylston
West Brookfield
W. Springfield
Westborough
Westfield
Westford
Westminster
Weston
Westwood
Wilbraham
Winchendon
Whately
Worcester
Wrentham

Figure 1610.1D
SNOW LOAD MAP - ZONE 4



List of Towns in Minimum Uniform
Snow Load Zones Zone 4

Adams
Alford
Ashfield

Becket
Blandford
Buckland

Charlemont
Cheshire
Chester
Chesterfield
Clarksburg
Colrain
Conway
Cummington

Dalton

Egremont

Florida

Goshen
Granville
Great Barrington
Hancock
Hawley
Heath
Hinsdale
Huntington

Lanesborough
Lee
Lenox
Leyden

Middlefield
Monroe
Monterey
Montgomery
Mount Washington

New Ashford
New Marlborough

North Adams

Otis

Peru
Pittsfield
Plainfield

Richmond
Rowe
Russell

Sandisfield
Savoy
Sheffield
Shelbourne
Stockbridge
Tolland
Tyringham

Washington
W. Stockbridge
Westhampton
Williamsburgh
Williamstown
Windsor
Worthington

1610.3 Symbols and notations: The following symbols and notations apply to the provisions of 780 CMR 1610.0.

a = roof slope expressed in degrees

A = coefficient for amount of sliding snow

A_d= crossectional area of drift surcharge, expressed in square feet

C_s= slope factor (See 780 CMR 1610.5)

D = density of snow, expressed in pounds per cubic foot (pcf)

h_b =height of uniform snow load on lower roof or deck, expressed in feet

h_d =maximum height of drift surcharge, expressed in feet

h_{dr} = reduced height of drift surchargfe, expressed in feet

H_{dl} = potential height of drift surcharge from snow blown from lower roof, expressed in feet

H_{dlr}=reduced height of drift surcharge from snow blown from lower roof, expressed in feet

H_{du} =potential height of drift surcharge from snow blown from upper roof, expressed in feet

H_{dur}=reduced height of drift surcharge from snow blown from upper roof, expressed in feet

h_r = difference in height between the upper and lower roof or deck, expressed in feet

L_T =the dimension of an upper roof or projecting element perpendicular to the wind flow (perpendicular to (W bu and W bl), expressed in feet

P_f = basic uniform snow load, expressed in pounds per square foot (psf)

P_s = intensity of sloped roof snow load, expressed in pounds per square foot (psf)

P_{ds} = maximum intensity of surcharge load from sliding snow, expressed in pounds per square foot (psf)

S = horizontal separation between adjacent structures, expressed in feet (See Figure 1610.7)

W_a = horizontal dimension, in feet, of upper sloping roof (See Figure 1610.10)

W_{bu} =horizontal dimension, in feet, of upper roof normal to the line of change in roof level (See Figure 1610.4)

W_{bl} =horizontal dimension, in feet, of lower roof normal to the line of change in roof level (See Figure 1610.4)

W_d = width of snow drift, expressed in feet (See Figure 1610.4)

W_s = width of sliding snow drift, expressed in feet (See Figure 1610.10)

1610.4 Uniform Snow Loads

1610.4.1 Uniform snow load for flat and low-sloped roofs with planar panels: the snow load on a flat roof or on a roof with planar panels which have a slope less than 30 degrees shall be equal to the basic snow load, P_f.

1610.4.2 Uniform snow load for sloped roofs with planar panels: The sloped roof snow load on roofs having a slope greater than 30 degress shall be calculated using the following formula:

$$P_s = C_s P_f \quad \text{(Equation 1)}$$

where "C_s" is determined by the following formula:

$$C_s = 1 - \frac{(a - 30)}{40} \quad \text{(Equation 2)}$$

and "a" is the slope of the roof expressed in degrees.

1610.4.3 Uniform snow load for convex curved roofs: Where the tangents to the surface of a convex curbed roof have slopes greater than 70 degrees, the point at which the slope of the tangent exceeds 70 degrees shall be considered the effective eave. The surface of a convex curved roof below the effective eave shall be considered free of snow. The snow load on a convex curved roof shall be determined by Equation 1, with "a" equal to the effective roof slope in degrees. The effective roof slope is equal to the slope of a chord from the eave or effective eave to the crown of the roof.

1610.4.4 Uniform snow load for concave curved roofs: The effective loaded area of a concave curved roof shall be that area of the surface of the roof where the tangents to the surface have a slope of 50 degrees or less. The total load on a concave curved roof shall be the basic snow load, P_f, multiplied by the total horizontal projected area of the roof. This total load shall be applied uniformly over the effective loaded area of the roof.

1610.4.5 Uniform Snow Loads for multiple roofs. For multiple folded-plate, sawtooth, and barrel vault roofs, the snow *load* shall be equal to the basic snow *load*, P_f, regardless of the slope of the roof.

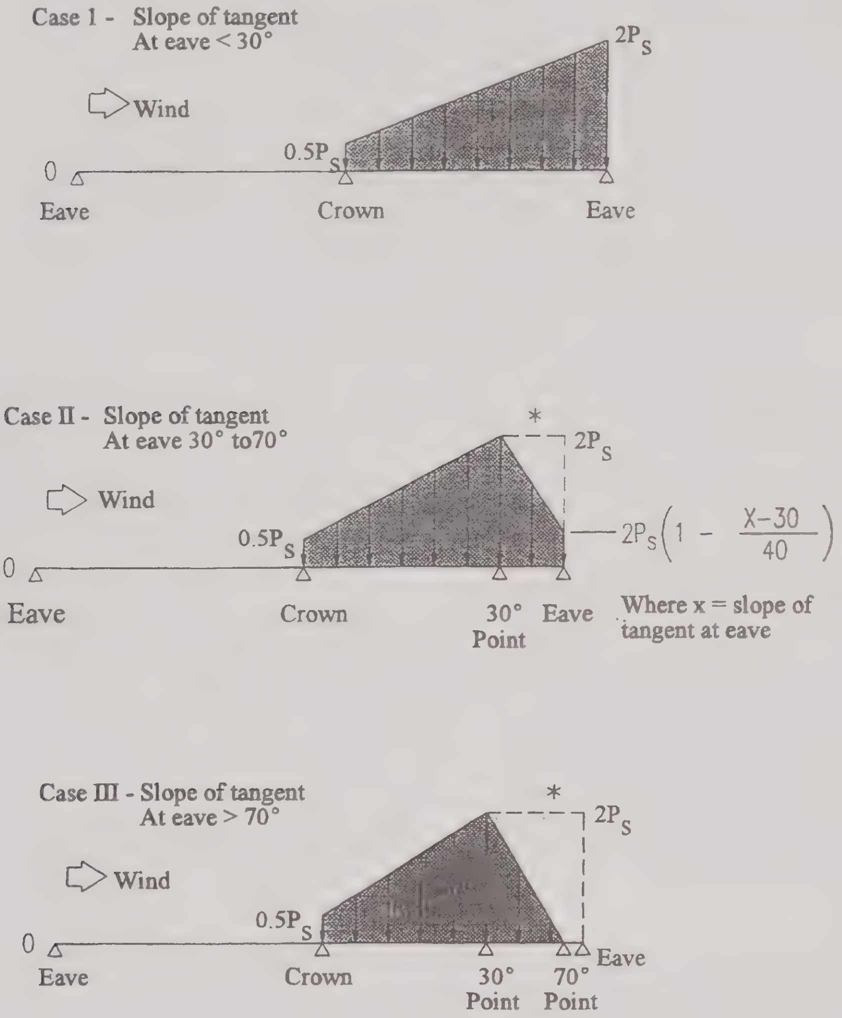
1610.5 Unbalanced Snow loads: Except as otherwise specifically provided in 780 CMR 1610.5.1 through 780 CMR 1610.5.3, unbalanced snow loads shall be applied in patterns of 100% of the uniform snow *load* alternating with 50% of the uniform snow *load*. The location and extent of the loadings in the patterns shall be such as to maximize the various structural effects.

1610.5.1 Unbalanced snow load for hip and gable roofs: For hip and gable roofs with slopes between 15 degrees and 70 degrees, the structure shall be designed to sustain an unbalanced uniform snow load on the leeward side of the roof equal to $1.5P_s$, where P_s is determined in accordance with 780 CMR 1610.4.2. The windward side of the roof shall be considered free from snow.

1610.5.2 Unbalanced snow load for convex curved roofs. For convex curved roofs with effective roof slopes between ten degrees and 60 degrees, determined in accordance with 780 CMR 1610.4.3, unbalanced snow *loads* shall be determined in accordance with the loading diagrams of Figure 1610.2. In all cases, the windward side shall be considered free of snow, and any portion of the leeward side of the roof where the slope of the tangent to the roof surface is greater than 70 degrees shall also be considered free from snow. If the ground or another roof abuts a Case-II or Case-III (see Figure 1610.2) convex curved roof structure at, or within three feet of its eave, the snow load distribution shall be in accordance with the dashed lines on Figure 1610.2.

Figure 1610.2

UNBALANCED LOADING CONDITIONS FOR CONVEX CURVED ROOFS



Case 1 - Slope of tangent At eave < 30°

Case II - Slope of tangent At eave 30° to70°

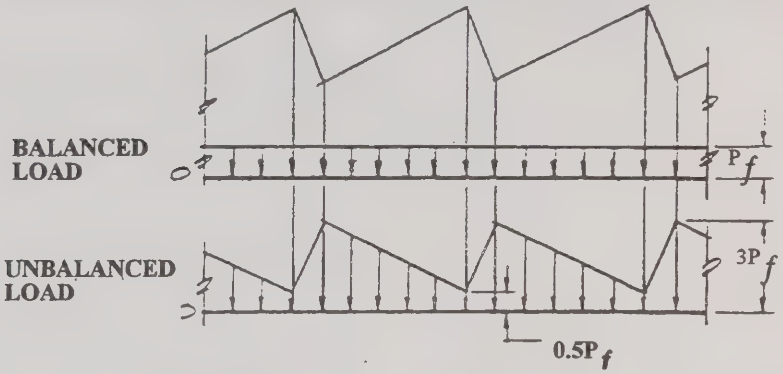
Case III - Slope of tangent At eave > 70°

Wind
0
0.5P_S
2P_S
Eave
Crown
Eave
*
2P_S
$2P_S\left(1 - \frac{X-30}{40}\right)$
30° Point
Where x = slope of tangent at eave
70° Point

***Distribution of snow load where the ground or another roof abuts at or less than 3'-0 from eave.**

1610.5.3 Unbalanced snow load for multiple roofs: For multiple folded-plate, sawtooth, and barrel vault roofs, the unbalanced snow load shall be as shown on Figure 1610.3. In the figures, P_f is the basic snow load intensity. The snow depth above the valleys need not exceed the level of the snow above the ridges, and the maximum snow *load* intensity in the valleys may be reduced accordingly. Snow depth and reduced snow *loads* shall be determined from the assumed density of snow, D, of 20 pcf.

Figure 1610.3
BALANCED AND UNBALANCED LOADS ON A SAWTOOTH ROOF



1610.6 Snow Drift loads at changes in roof elevation and at roof projections: Multi-level roofs, lower roofs and decks of adjacent structures, and roofs adjacent to projections shall be designed in accordance with 780 CMR 1610.6.1 through 1610.6.6.

1610.6.1 Design loads at changes in roof elevation: The drift load on lower roofs or decks at changes in roof or deck elevation shall be taken as the triangular loading surcharge superimposed on the uniform roof snow *load*, P_f, as shown in Figure 1610.4

Two types of drifts shall be considered:

1. from wind blowing snow from the upper roof
2. from wind in the opposite direction blowing snow from the lower roof

The drift causing the more severe structural effect shall be used for design

The density of snow, *D* in a snowdrift and in the uniform layer of snow underlying the drift shall be not less than:

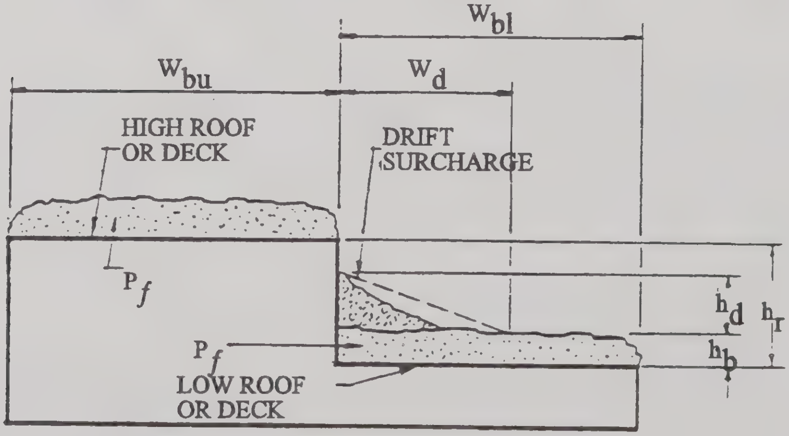
$$D = 20pcf \qquad \text{(Equation 3)}$$

The height, h_b, of the uniform snow layer underlying the drift shall be:

$$h_b = \frac{P_f}{D} \qquad \text{(Equation 4)}$$

The intensity of snow load at any point shall be the total depth, at that point, of the snowdrift and the underlying uniform layer of snow, times the density, D.

Figure 1610.4
DRIFTING SNOW ON LOWER ROOFS AND DECKS AT CHANGES IN ROOF OR DECK ELEVATIONS



1610.6.1.1 Drifting of snow from upper roof: The height of drift, h_d, and the width of drift, W_d, both in feet shall be determined as follows:

a. Compute the potential drift height H_{du}, in feet, and the cross-sectional areas of drift, A_d, in square feet, as:

$$H_{du} = 1.15(W_{bu})^{0.33} - 1.5 \qquad \text{(Equation 5)}$$

(Alternately, H_{du} may be determined from Figure 1610.5)

$$A_d = \frac{(H_{du})(4H_{du})}{2} = 2H_{du}^2 \qquad \text{(Equation 6)}$$

b: If $(H_{du} + h_b)$ is less than or equal to the difference in roof elevations, h_r, then:

$$H_d = H_{du} \qquad \text{(Equation 7)}$$

$$W_d = 4(H_{du}) \qquad \text{(Equation 8)}$$

c: If $(H_{du} + h_b)$ is greater than h_r:

$$h_d = h_r - h_b \qquad \text{(Equation 9)}$$

$$W_d = \frac{2(A_d)}{h_r - h_b} \qquad \text{(Equation 10)}$$

W_d need not exceed $10\ (h_r - h_b)$

1610.6.1.2 Drifting of snow from lower roof: The height of drift, h_d, and the width of drift, W_d, both in feet shall be determined as follows:

a. Compute the potential drift height, H_{dl}, in feet, as:

$$H_{dl} = 0.5[1.15(W_{bl})^{0.33} - 1.5] \qquad \text{(Equation 11)}$$

(Alternatively, H_{dl} may be determined from Figure 1610.5)

b. If $(H_{dl} + h_b)$ is less than or equal to h_r, then:

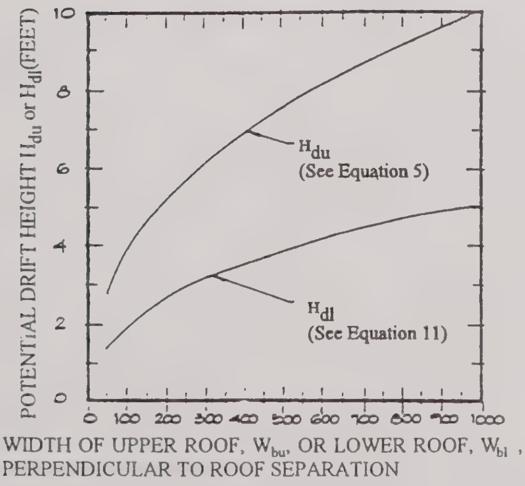
$$h_d = H_{dl} \qquad \text{(Equation 12)}$$

c. If $(H_{dl} + h_b)$ is greater than h_r, then:

$$h_d = h_r - h_b \qquad \text{(Equation 13)}$$

$$W_d = 8(h_d) \qquad \text{(Equation 14)}$$

Figure 1610.5
HEIGHT OF DRIFT AT CHANGE IN ROOF ELEVATION



1610.6.1.3 Multiple level roofs: For multiple stepped roofs similar to that shown in Figure 1610.6a, the sum of all the roof lengths upwind above the drift under consideration shall be considered as the length of upper roof for that drift (as shown, for example, in Figure 1610.6a).

For multiple level roofs similar to that shown in Figure 1610.6b, if the total calculated height of a drift and the underlying uniform snow layer on the upwind side of a higher roof ($h'_d + h_b$) is equal to or greater than $0.7h_r$, then the length, W_{bu} *, as shown in Figure 1610.6b, shall be used in place of W_{bu} in Equation 5.

1610.6.2 Drift loads on adjacent lower structures: A drift surcharge shall be applied to roofs of lower adjacent structures if these structures are located within a distance of W_d, but not greater than 20 feet, of the higher structure as depicted in Figure 1610.7. The height of drift h_d and the width of drift W_d shall be computed for wind in either direction, in accordance with 780 CMR 1610.6.1, assuming, for these computations only that there is no space between the higher and lower structures. The actual triangular drift surcharge on the roof of the lower structure shall be as shown in Figure 1610.7.

Figure 1610.6
DRIFTING SNOW AT MULTIPLE CHANGES IN ROOF ELEVATION
Figure 1610.6a

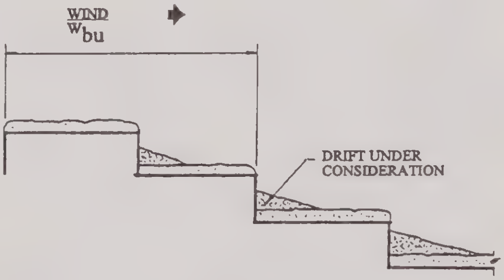
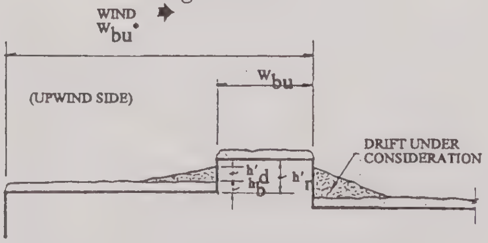
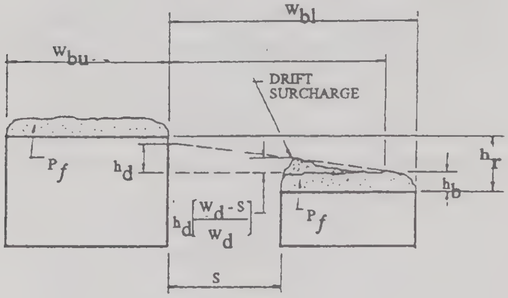


Figure 1610.6b



NOTE: Use W_{bu}^* when $h'_d + h_b \geq 7h'_r$.

Figure 1610.7
DRIFTING SNOW ON TO ADJACENT LOW STRUCTURES


w_{bl}
w_{bu}
DRIFT SURCHARGE
P_f
h_d
h_r
h_b
$h_d\left[\frac{w_d - S}{w_d}\right]$
P_f
S

NOTE: Drift surcharge required only when $S \le W_d$ and $S \le 20$ Ft.

Figure 1610.8
SNOW DRIFTING AT ROOF PROJECTIONS

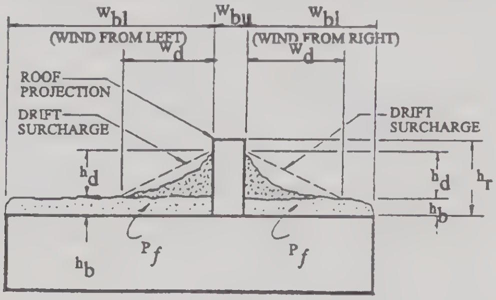

w_{bl}
w_{bu}
w_{bl}
(WIND FROM LEFT)
(WIND FROM RIGHT)
w_d
w_d
ROOF PROJECTION
DRIFT SURCHARGE
DRIFT SURCHARGE
h_d
h_d
h_r
h_b
h_b
P_f
P_f

Figure 1610.9
INTERSECTING SNOW DRIFTS

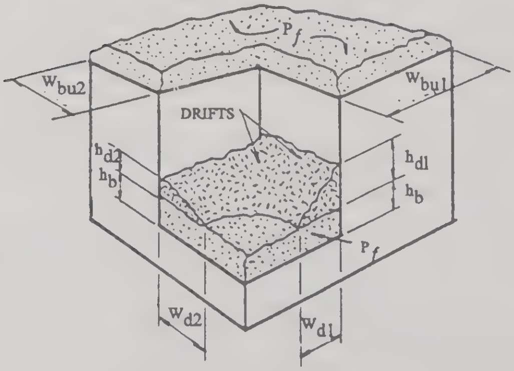
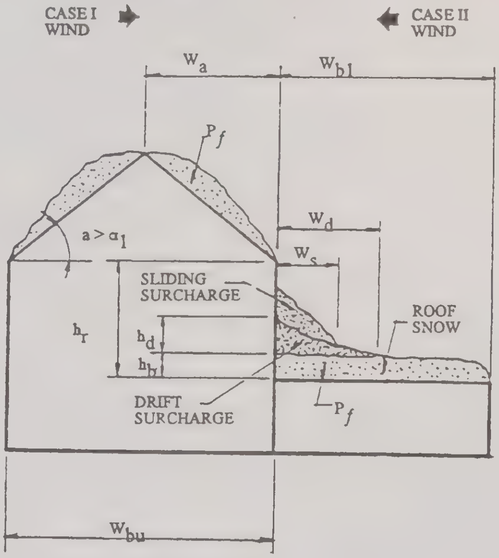

P_f
w_{bu2}
w_{bu1}
DRIFTS
h_{d2}
h_b
h_{d1}
h_b
P_f
w_{d2}
w_{d1}

Figure 1610.10
ADDITIONAL SURCHARGE DUE TO SLIDING SNOW


CASE I WIND
CASE II WIND
w_a
w_{bl}
P_f
$a > \alpha_1$
w_d
w_s
SLIDING SURCHARGE
ROOF SNOW
h_r
h_d
h_b
DRIFT SURCHARGE
P_f
w_{bu}

$\alpha_1 = 15°$ SMOOTH SURFACES (METAL OR SLATE)

$a_1 = 25°$ OTHER SURFACES

1610.6.3 Very high roof separations: When the ratio h_r/L_T is greater than 1.0, where L_T is the dimension in feet of the upper roof perpendicular to the wind flow (perpendicular to W_{bu} and W_{bl}), the drift surcharge load on the lower roof due to drifting of snow from the upper roof may be reduced. The reduced height of the drift surcharge, H_{dur}, shall be not less than:

$$H_{dur} = H_{du}\left(2 - \frac{h_r}{L_T}\right) \qquad \text{(Equation 15)}$$

except that when h_r/L_T is greater than 2.0, H_{dur} shall be equal to zero.

1610.6.4 Limited extent of upper roof: When L_T, the dimension in feet of an upper roof or projecting element perpendicular to the wind flow, (perpendicular to W_{bu} and W_{bl}) is less than 20 feet, the potential height of drift may be reduced and shall not be less than:

$$H_{dur} = \frac{L_T}{20}(H_{du}) \qquad \text{(Equation 16)}$$

$$H_{dlr} = \frac{L_T}{20}(H_{dl}) \qquad \text{(Equation 17)}$$

1610.6.5 Parapets and other roof projections: Design drift *loads* for roofs adjacent to parapets and other roof projections, as shown in Figure 1610.8, shall be determined in accordance with 780 CMR 1610.6.1 and 1610.6.4. Drifts due to snow from the top of a roof projection need only be considered when W_{bu} is ten feet or greater.

1610.6.6 Intersecting drifts: When one snow drift intersects another at an angle as shown in Figure 1610.9, the unit snow load at any point shall be not less than the greater of the unit *loads* from the two individual drifts, plus the unit load of the underlying uniform snow layer.

1610.7 Sliding snow from sloped upper roofs: Two cases of drift loading shall be considered for roofs which are located below upper sloped roofs, as shown in Figure 1610.10 and as follows:

(a) Case I Drift loading due to snow from the upper roof computed in accordance with 780 CMR 1610.6.1, but without load from sliding snow (W_{bu} is the full width of the upper roof as shown in Figure 1610.10.)

(b) Case II Drift loading due to snow from the lower roof computed in accordance with 780 CMR 1610.6.1 and a sliding snow surcharge load as specified below and as shown in Figure 1610.10.

The maximum intensity of the sliding snow load, P_{ds}, shall be:

$$P_{ds} = \frac{AW_a}{W_s}(P_f) \qquad \text{(Equation 18)}$$

where W_a and W_s are defined in Figure 1610.10 and the coefficient A is defined as follows:

(a) For roof surfaces of metal and slate, and for other roof surfaces smoother than mineral surfaced roofing: If the angle of slope of the upper roof, "*a*", as shown in Figure 1610.10 is equal to or greater than 15 degrees (slope 3.2 in 12), A = 1.6; if "a" is less than 15 degrees, A = 0 (no sliding snow load).

(b) For roof surfaces of mineral surfaced roofing or rougher surfaces:

If "a" is equal to or greater than 25 degrees (slope 5.6 in 12), A = 1.0;
if "a" is less than 25 degrees, A = 0.

The value of W_s, the width of the sliding snow surcharge, shall be computed as follows:

(a) For "*a*" less than or equal to 45 degrees,

$$W_s = h_r \qquad \text{(Equation 19)}$$

or

$$W_s = \frac{W_a}{4} \qquad \text{(Equation 20)}$$

whichever is greater.

(b) For "a" greater than or equal to 45°

$$W_s + h_r(\cot a) \qquad \text{(Equation 21)}$$

or

$$W_s = \frac{W_a}{4} \qquad \text{(Equation 22)}$$

whichever is greater

1610.7.1 Snow guards: Sliding snow from an adjacent sloping high roof need not be considered on the low roof if proper snow guards are provided on the high roof. In this case, the sloping roof with snow guards shall be designed for the unit snow *loads* required for a flat roof.

1610.8 Snow pockets or wells: Account shall be taken of the load effects of potentially excessive snow accumulation in pockets or wells of roofs or decks.

1610.9 Snow storage and collection areas: Consideration of potentially excessive snow accumulation shall be given to portions of structures which may be designed or used as snow collection or storage areas during and after snow removal operations.

780 CMR 1611.0 WIND LOAD

1611.1 Wind load zones: The locations of *wind load* zones are shown in the Figures 1611.1A, 1611.1B, 1611.1C maps. Zone 1 consists of the Counties of Berkshire, Franklin, Hampshire and Hampden; Zone 2 consists of the County of Worcester; and Zone 3 consists of the Counties of Essex, Middlesex, Suffolk, Norfolk, Plymouth, Bristol, Barnstable, Dukes and Nantucket.

1611.2 Exposures: Exposure is defined as a measure of terrain roughness and is classfied as follows:

Exposure A: centers of large cities and very rough, hilly terrain. Exposure A applies for downtown areas only when the terrain for at least one half mile upwind of the structure is heavily built up, with at least 50% of the buildings being in excess of four stories, and when Exposure B prevails beyond this boundary.

Exercise caution in using these reduced wind pressures for buildings and structures on high ground in the midst of cities or rough terrain.

Exposure B: suburban areas, towns, city outskirts, wooded areas, and rolling terrain. Exposure B applies only when the terrain for at least one half mile upwind is a continuous urban development, forest, wooded area, or rolling terrain.

Exposure C: open level terrain with only scattered buildings, structures, trees or miscellaneous obstructions, open water, or shorelines.

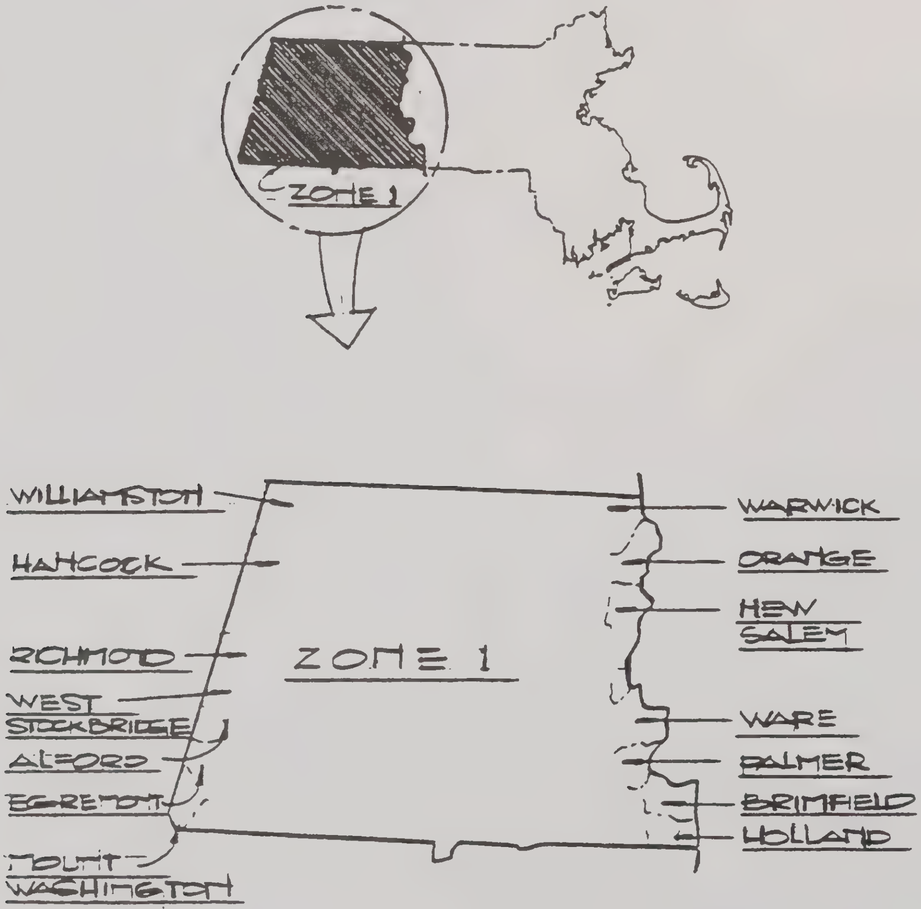
1611.2.1 Special exposures: Consideration shall be given to the application of a more severe exposure (e.g., Exposure C instead of Exposures B or A) when the ground slope near the site of a structure changes abruptly, in order to account for the resulting higher wind speeds near ground level.

1611.3 Reference wind velocities: The reference wind velocity for each *wind load* zone is the "fastest-mile" wind velocity, in miles per hour, at 30 feet about the ground (V_{30}) for Exposure C, as shown in Table 1611.3:

Table 1611.3

Zone	V_{30} (mph)
1	70
2	80
3	90

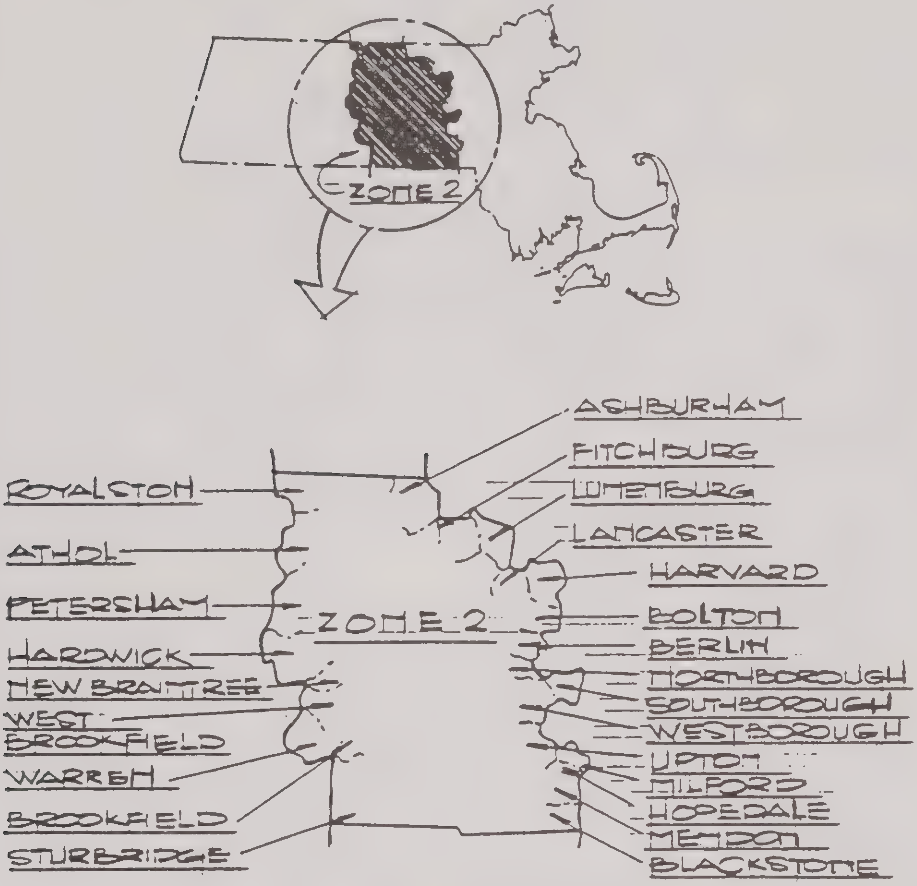
Figure 1611.1A
WIND LOAD MAP - ZONE 1



List of Towns: Wind Load Zones
Zone 1

Adams
Agawam
Alford
Amherst
Ashfield
Becket
Belchertown
Bernardston
Blandford
Brimfield
Buckland
Charlemont
Cheshire
Chester
Chesterfield
Chicopee
Clarksburg
Colrain
Conway
Cummington
Dalton
Deerfield
E. Longmeadow
Easthampton
Egremont
Erving
Florida
Gill
Goshen
Granby
Granville
Great Barrington
Greenfield
Hadley
Hampden
Hancock
Hatfield
Hawley
Heath
Hinsdale
Holland
Holyoke
Huntington
Lanesborough
Lee
Lenox
Leverett
Leyden
Longmeadow
Ludlow
Middlefield
Monroe
Monson
Montague
Monterey
Montgomery
Mount Washington
New Ashford
New Marlborough
New Salem
North Adams
Northampton
Northfield
Orange
Otis
Palmer
Pelham
Peru
Pittsfield
Plainfield
Richmond
Rowe
Russell
Sandisfield
Savoy
Sheffield
Shelbourne
Shutesbury
S. Hadley
Southampton
Southwick
Springfield
Stockbridge
Sunderland
Tolland
Tyringham
Wales
Ware
Warwick
Washington
Wendell
W. Springfield
W. Stockbridge
Westfield
Westhampton
Whately
Wilbraham
Williamsburgh
Wiliamstown
Windsor
Worthington

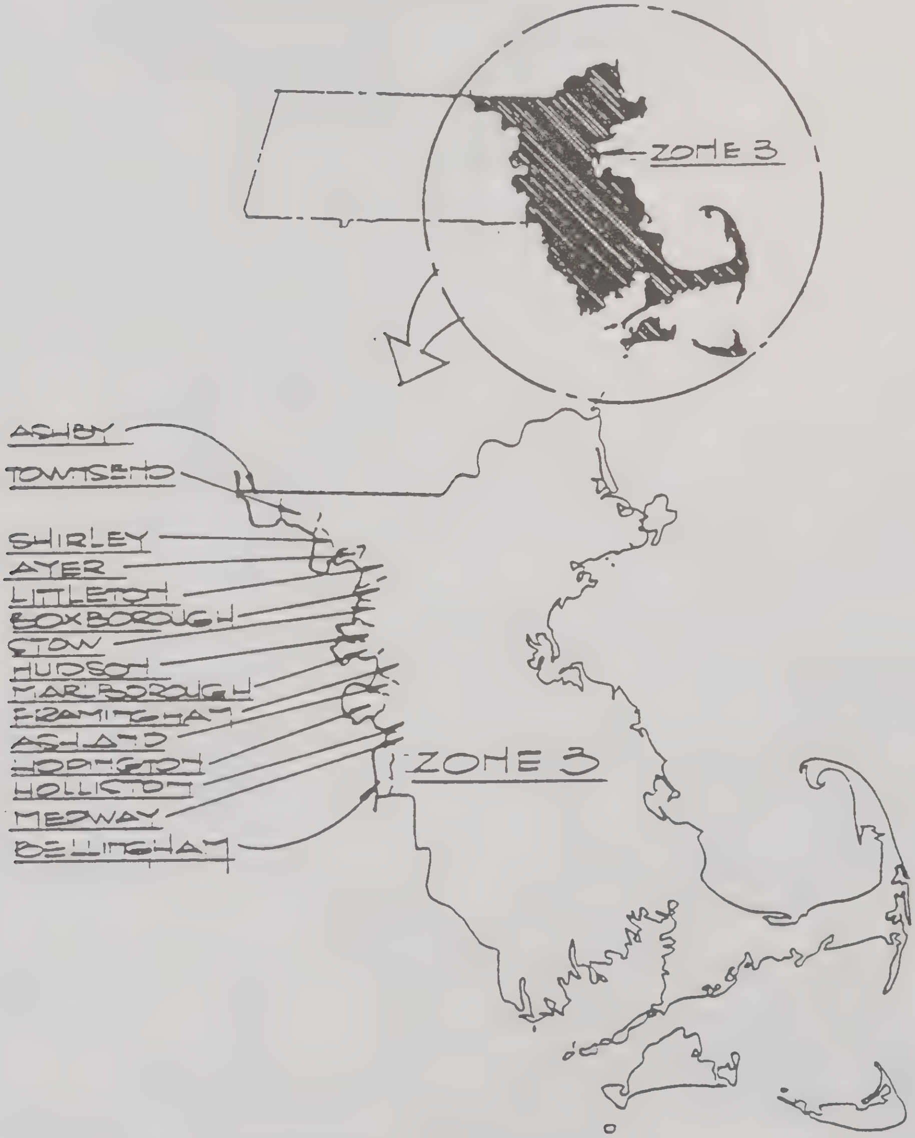
FIGURE 1611.1b
WIND LOAD MAP - ZONE 2


ZONE 2
ASHBURHAM
FITCHBURG
LUNENBURG
LANCASTER
HARVARD
ROYALSTON
ATHOL
PETERSHAM
ZONE 2
BOLTON
BERLIN
HARDWICK
NEW BRAINTREE
NORTHBOROUGH
SOUTHBOROUGH
WEST BROOKFIELD
WESTBOROUGH
WARREN
UPTON
MILFORD
HOPEDALE
BROOKFIELD
MENDON
STURBRIDGE
BLACKSTONE

List of Towns: Wind Load Zones
Zone 2

Asburnham
Athol
Auburn
Barre
Berlin
Blackstone
Bolton
Boylston
Brookfield
Charlton
Clinton
Douglas
Dudley
E. Brookfield
Fitchburg
Gardner
Grafton
Harvard
Hardwick
Holden
Hopedale
Hubbardston
Lancaster
Leicester
Leominster
Lundenburg
Mendon
Milford
Millbury
Millville
New Braintree
N. Brookfield
Northborough
Northbridge
Oakham
Oxford
Paxton
Petersham
Phillipston
Princeton
Royalston
Rutland
Shrewsbury
Southborough
Southbridge
Spencer
Sterling
Sturbridge
Sutton
Templeton
Upton
Uxbridge
Warren
Webster
W. Boylston
W. Brookfield
Westborough
Westminster
Winchedon
Worcester

FIGURE 1611.1C
WIND LOAD MAP - ZONE 3



List of Towns: Wind Load Zones
Zone 3

Abington
Acton
Accushnet
Amesbury
Andover
Arlington
Ashby
Ashland
Attleboro
Avon
Ayer
Barnstable
Bedford
Bellingham
Belmont
Berkley
Beverly
Billerica
Boston
Boxborough
Boxford
Bourne
Braintree
Brewster
Bridgewater
Brockton
Brookline
Burlington
Cambridge
Canton
Carlisle
Carver
Chatham
Chemlsford
Chelsea
Chilmark
Cohasset
Concord
Danvers
Dartmouth
Dedham
Dennis
Dighton
Dover
Dracut
Dunstable
Duxbury
E. Bridgewater
Eastham
Easton
Edgartown
Essex
Everett
Fairhaven
Fall River
Falmouth
Foxborough
Framingham
Franklin
Freetown
Gay Head
Georgetown
Gloucester
Gosnold
Groton
Groveland
Halifax
Hamilton
Hanover
Hanson
Harwich
Haverhill
Hingham
Holbrook
Holliston
Hopkinton
Hudson
Hull
Ipswich
Kingston
Lakeville
Lawrence
Lexington
Lincoln
Littleton
Lowell
Lynn
Lynnfield
Malden
Manchester
Mansfield
Marblehead
Marion
Marlborough
Marshfield
Mashpee
Mattapoisett
Maynard
Medfield
Medford
Medway
Melrose
Merrimac
Methuen
Middleborough
Middleton
Millis
Milton
Nahant
Nantucket
Natick
Needham
New Bedford
Newbury
Newburyport
Newton
Norfolk
N. Andover
N. Attleboro
N. Reading
Norton
Norwell
Norwood
Oak Bluffs
Orleans
Peabody

Pembroke
Pepperell
Plainville
Plymouth
Plympton
Provincetown
Quincy
Randolph
Raynham
Reading
Rehoboth
Revere
Rochester
Rockland
Rockport
Rowley
Salem
Salisbury
Sandwich
Saugus
Scituate
Seekonk
Sharon
Sherborn
Shirley
Somerset
Somerville
Stoneham
Stoughton
Stow
Sudbury
Swampscott
Swansea
Taunton
Tewksbury
Tisbury
Topsfield
Townsend
Truro
Tyngsborough
Vineyard Haven
Wakefield
Walpole
Waltham
Wareham
Watertown
Wayland
Wellesley
Wellfleet
Wenham
W. Bridgewater
Westford
W. Newbury
Weston
Westport
W. Tisbury
Westwood
Weymouth
Whitman
Wilmington
Winchester
Winthrop
Woburn
Wrentham
Yarmouth

1611.4 Reference wind pressures: Reference wind pressures for the various exposures and wind zones are given in the following Table 1611.4. The tabulated pressures are combined windward and leeward pressures representing the overall effect of the wind on essentially rectangular structures, and account for typical gust effects as found in ordinary buildings. These pressures do not account for buffeting or channeling caused by positions of nearby structures, vortex shedding, or wind sensitive dynamic properties of a particular structure.

1611.5 Wind loads on structures as a whole: All buildings and enclosed or partially enclosed structures shall be designed to withstand a total *wind load* acting on the structure as a whole determined by applying the appropriate reference wind pressures given in Table 1611.4 or 1611.4a, to the vertical projected area, normal to the wind direction of the vertical surfaces of the structure, plus the appropriate wind forces on the roof as specified in 780 CMR 1611.8. Consideration shall be given to wind acting in all directions.

1611.5.1 Simultaneous wind forces on orthogonal sides: For structures which are essentially rectangular in plan, or whose plan shape is made up of rectangular parts, only wind directions normal to the sides of the structure need be considered, provided that 0.7 times the effects of the wind acting simultaneously normal to adjacent orthogonal sides shall also be considered when it produces more severe effects in the structural support system. Factors other than 0.7 may be used if substantiated by appropriate wind tunnel tests.

1611.5.2 Wind force distribution: The total wind force on the vertical surfaces of a structure prescribed in 780 CMR 1611.5 shall be distributed 6/10 to the windward surfaces (as a positive pressure) and 4/10 to the leeward surfaces (as a suction). Other distributions may be used if substantiated by appropriate wind tunnel tests.

1611.6 Vertical parts of structures: Vertical parts of structures that are subjected directly to the wind, and their local supporting elements, shall be designed to resist the pressures listed in Table 1611.6, normal to the surface, inward or outward. The pressures listed in the table represent the combined internal and external pressures. A local supporting element of a vertical part subjected directly to the wind shall be defined as a wall assembly, a stud, a mullion, a girt, or a similar item which distributes the *wind load* from the vertical part to the principal structural system of the structure.

TABLE 1611.4
REFERENCE WIND PRESSURE (POUNDS PER SQUARE FOOT)

Height above grade	Zone 1			Zone 2			Zone 3		
	Exposure			Exposure			Exposure		
H (feet)	A	B	C	A	B	C	A	B	C
0 - 50	11	12	12	11	17	17	14	21	21
50 - 100	11	12	18	11	17	24	14	21	31
100 - 150	11	16	22	14	21	29	18	26	37
150 - 200	13	18	25	17	24	33	22	30	41
200 - 250	15	20	27	20	27	36	25	34	45
250 - 300	17	22	29	22	30	39	28	37	48
300 - 400	19	25	31	25	33	42	32	41	52
400 - 500	22	28	34	29	37	46	36	46	57
500 - 600	24	30	37	33	41	49	41	51	61
600 - 700	27	33	39	36	44	52	45	55	65
700 - 800	29	35	41	39	47	55	48	58	68
800 - 900	31	37	43	41	49	57	52	62	72
900 - 1000	33	39	45	44	52	59	55	65	74

See table 1611.1a for empirical wind pressure formulas

TABLE 1611.4a
EMPIRICAL WIND PRESSURE FORMULAS[a]

Zone 1			Zone 2			Zone 3		
Exposure			Exposure			Exposure		
A	B	C	A	B	C	A	B	C
$p = 30 (h/800)^{0.55}$	$p = 36 (h/800)^{0.45}$	$p = 42 (h/800)^{0.35}$	$p = 40 (h/800)^{0.55}$	$p = 48 (h/800)^{0.45}$	$p = 56 (h/800)^{0.35}$	$p = 50 (h/800)^{0.55}$	$p = 60 (h/800)^{0.45}$	$p = 70 (h/800)^{0.35}$

Note a: Empirical wind pressure formulas may be used in lieu of the reference wind pressures in table 1611.1

TABLE 1611.6
WIND PRESSURES ON PARTS OF STRUCTURES AND LOCAL SUPPORTING ELEMENTS

Location of applied wind pressure	Tributary *wind load* area of part or local supporting element	Required Design Pressures		
		Reference pressure of 780 CMR 1611.4 multiplied by[1]	But not less than	But need not be greater than
Within salient corner area[2]	Any	1.7	20 psf	70 psf
Beyond salient corner area	Less than or equal to 200 sf	1.2	20 psf	50 psf
Beyond salient corner area	Greater than 200 sf	0.8	15 psf	50 psf

Note 1: For partially enclosed structures, where any side is more than 35% open, add a factor of 0.3 to the coefficients of this column of the table

Note 2: The salient corner shall be defined as the vertical surface located within a distance of 1/10 the least width of the structure, but not more than ten feet, from a prominent (salient) corner.

TABLE 1611.8
EXTERNAL WIND PRESSURES ON ROOFS

External Wind Pressure - flat, gable, shed roofs (wind perpendicular to ridge)

Roof pitch		Multiples of reference wind pressure of 780 CMR 1611.4		
Degrees	Rise/run	Windward slope		Leeward slope Suction
		Positive pressure	Suction	
0-20	Flat to 4/12	---	0.6	0.5
20-30	4/12 to 7/12	0.2	0.5	0.5
30-40	7/12 to 10/12	0.3	0.4	0.5
40-50	10/12 to 14/12	0.4	0.3	0.5
50-90	14/12 to vertical	0.6	---	0.5

External Wind Pressure - arch shaped roofs (wind perpendicular to ridge)

Rise to span ratio	Multiples of reference wind pressure of 780 CMR 1611.4			
	Windward quarter		Center half	Leeward quarter
	Positive pressure	Suction	Suction	Suction
Less than 2/10	0.2	0.7	0.7	0.4
2/10 to 3/10	0.3	---	0.8	0.4
3/10 to 6/10	0.6	---	1.0	0.4

External wind pressure - flat, gable, shed or arched shaped roofs (wind parallel to ridge)

All	Suction of 0.6 multiplied by the reference wind pressure of 780 CMR 1611.4

1611.7 Wind loads on roofs: Roofs and their supporting structure shall be designed to resist the combined effects of the external and internal wind pressures specified in 780 CMR 1611.8 through 1611.11. All pressures specified shall be considered to act normal to the roof surface. When applying the reference wind pressures of 780 CMR 1611.4 to the provisions of 780 CMR 1611.8 through 1611.11, the reference wind pressures shall be for a height equal to the average height of the roof eave above grade.

1611.8 External wind pressures on roofs of enclosed structures: Except as specified otherwise in 780 CMR 1611.11, external wind pressures shall be specified in Table 1611.8, or 780 CMR 1611.8. Where both positive pressure and suction are specified, the effects of each shall be evaluated.

1611.8.1 Roof shapes not specified: For roof shapes not specified herein, external wind pressures shall be determined as specified in 780 CMR 1611.13 but the minimum suction effect shall be equal to 0.6 times the reference wind pressure of 780 CMR 1611.4.

1611.9 Internal wind pressures on roofs of enclosed structures: Except as specified otherwise in 780 CMR 1611.10, internal wind pressures shall be 0.2 times the reference wind pressure given in 780 CMR 1611.4. The internal pressure shall be applied as a positive pressure or a suction, whichever gives the greater structural effect when added to the external pressure, for the design of each structural component.

1611.10 Wind pressures on roofs over nonenclosed or partially enclosed structures: Except as specified otherwise in 780 CMR 1611.11, wind pressures for roofs of partially enclosed or nonenclosed structures shall be as follows:

1. When a structure is partially enclosed, with each side not more than 35% open, the wind pressure shall be the same as for an enclosed structure.
2. When a structure is partially enclosed, with openings essentially all on one side, and when that side is more than 35% open, external wind pressure shall be as specified in Table 1611.4 or Table 1611.4a and internal wind pressures shall be as specified in 780 CMR 1611.9 except that the value of internal wind pressure shall be equal to 0.5 times the reference wind pressure given in Table 1611.3.
3. For all other cases of partially enclosed structures, or for nonenclosed structures, the combined effect of the wind pressures above and below roofs shall be equal to 1.25 times the values specified in Table 1611.8 for the corresponding roof shapes and wind directions.

1611.11 Wind pressures for parts of roofs: Parts of roofs that are subject directly to the wind, and their local supporting elements, shall be designed to resist the following pressures in an outward direction:

1. Where parts of roofs subjected directly to the wind are located within a distance of 1/10 the least width of a structure, but not more than ten feet, from the ridge, eave, or cornice, they shall resist a pressure 1.7 times the reference wind pressure given in Table 1611.4 (representing the combined internal and external pressures).
2. Where parts of roofs subjected directly to the wind are located outside the zones specified in 780 CMR 1611.11.1 they shall resist pressures as specified in 780 CMR 1611.8 through 1611.10 and Table 1611.8.

A local supporting element of a part of a roof shall be defined as a roof deck element, purlin, rafter, or similar item which distributes the *wind load* from the roof part to the principal structural system of the structure.

1611.12 Wind load on signs, towers, exposed framing, tanks, stacks and chimneys: Signs, towers, exposed framing, tanks, stacks, chimneys, and similar structures, or parts thereof, shall be designed for wind forces determined by applying coefficients given for the applicable structure in Tables 12 through 16 of ASCE-7 for the applicable reference wind pressures given in Table 1611.4, multiplied by 0.75.

1611.12.1 Shielding: Shielding effect of one element by another shall not be considered when the distance between them exceeds four times the projected smallest dimensions of the windward element.

1611.12.2 Signs: For open or solid outdoor signs with ratios of dimensions with the limits stated below, a *wind load* applied uniformly over the area of the sign and determined by the lesser of 1.2P on the projected gross area within the outside dimensions of the sign, or 1.6P on the net projected area of the sign; whichever is less, may be used in lieu of the *loads* given in ASCE 7, where "P" is the reference wind pressure given in Table 1611.4 for a height equal to the average height of the sign above the ground.

1. Ground supported signs (whose bottom is 0.25 times the vertical height from the ground to the top of the sign): height to width ratio less than ten.
2. Above ground signs: largest to smallest dimension ratio less than 20.

1611.13 Wind forces and pressures using wind tunnel tests: Design wind forces and pressures may be determined by appropriate wind tunnel tests on specific structures as stipulated by the responsible design engineer and approved by the building official. The wind tunnel test program shall adequately represent the relevant properties of the structure and its surroundings and the oncoming wind flow. The wind tunnel tests may be combined with a detailed statistical study of meteorological records, including high level wind velocity and direction, from stations near the proposed structure. The wind effects used for design of the structure shall be not less than those corresponding to an event having an annual probability of occurrence of 0.01. In lieu of a detailed statistical study of meteorological records, the appropriate reference wind velocity stipulated in 780 CMR 1611.3 may be used.

The wind forces and pressures so determined, plus an appropriate allowance for stack effects and internal pressures may be used for the design of the structure as a whole, and its individual parts. However, these values of forces and pressures shall not be less than .8 of the values required by 780 CMR 1611.5, 1611.7 and 1611.12, as applicable, for reference wind pressures for Exposure A and the appropriate wind zone specified in Table 1611.4.

1611.14 Uplift, overturning and sliding:

1611.14.1 Anchorage, roofs and walls: All parts of a structure subjected directly to the wind shall be anchored to the supporting structure, to resist specified *wind loads* inwardly or outwardly.

1611.14.2 Anchorage, structural system: The design of the structural system and its elements for uplift, overturning moment, or horizontal shear, or their combination, shall provide anchorage resistance required by the load combinations specified in 780 CMR 1616.0

1611.15 Eccentricity of wind forces: Consideration shall be given to the effects of specified wind forces being applied eccentrically to the center of rigidity of a structure.

780 CMR 1612.0 EARTHQUAKE LOADS

1612.1 Purpose: 780 CMR 1612.0 presents criteria for the design and construction of buildings and structures subject to earthquake ground motions. The purposes of 780 CMR 1612.0 is to minimize the hazard to life to occupants of all buildings and non building structures, to increase the expected performance of higher occupancy structures as compared to ordinary structures, and to improve the capability of essential facilities to function during and after an earthquake. Because of the complexity of and the great number of variables involved in seismic design (e.g. the variability in ground motion, soil types, dynamic characteristics of the structure, material strength properties and construction practices), 780 CMR 1612.0 presents only minimum criteria in general terms. These minimum criteria are considered to be prudent and economically justified for the protection of life safety in buildings subject to earthquakes. It must be emphasized that absolute safety and prevention of damage, even in an earthquake event with a reasonable probability of occurrence, cannot be achieved economically for most buildings.

The "design earthquake" ground motion levels specified herein may result in both structural and non structural damage. For most structures designed and constructed according to 780 CMR 1612.0, it is expected that structural damage from a major earthquake may be repairable but the repair may not be economical. For ground motions larger than the design levels, the intent of 780 CMR 1612.0 is that there be a low likelihood of building collapse.

1612.2 General: Every building and structure shall be designed and constructed to resist the effects of earthquake motions determined in accordance with this section. Additions and changes of occupancy to existing buildings and structures shall be designed and constructed to resist the effects of earthquake motions determined in accordance with this section. Special structures, including but not limited to vehicular bridges, transmission towers, industrial towers and equipment, piers and wharves, and hydraulic structures shall be designed for *earthquake loads* utilizing an approved, substantiated analysis.

Exceptions:

1. Detached one- and two-family dwellings are exempt from the requirements of 780 CMR 1612.2.
2. Agricultural storage buildings which are intended only for incidental human occupancy are exempt from the requirements of 780 CMR 1612.2

1612.2.1 Additions to existing buildings: An addition to an existing building shall be designed and constructed in accordance with the requirements of 780 CMR 34.

1612.2.2 Change of occupancy: Where a change of occupancy occurs in an existing building, the building shall conform to the provisions of 780 CMR 34.

1612.2.3 Seismic ground acceleration maps: The effective peak velocity-related acceleration (A_v) and the effective peak acceleration (A_a) shall each be taken as 0.12g throughout Massachusetts for the purposes of seismic design in accordance with 780 CMR.

1612.2.4 Site-specific response spectra: Where site-specific response spectra are required for buildings assigned to Seismic Performance Category D in accordance with Table 1612.4.6.2. the site-specific response spectra shall be developed based on ground motions which have a 90% probability of not being exceeded in 50 years.

1612.2.5 Seismic Hazard Exposure Groups: All buildings shall be assigned to one of the Seismic Hazard Exposure Groups in accordance with Table 1612.2.5.

1612.2.5.1 Multiple occupancies: Where a building is occupied for two or more occupancies not included in the same Seismic Hazard Exposure Group, the building shall be assigned the classification of the highest Seismic Hazard Exposure Group occupancy.

Table 1612.2.5
SEISMIC HAZARD EXPOSURE GROUP

Seismic Hazard Exposure Group type and description	Nature of occupancy
Group I	All occupancies except those listed below
Group II Seismic Hazard Exposure Group II buildings are those which have a substantial public hazard due to occupancy or use,. including buildings containing any one or more of the indicated occupancies	1. Use Group A in which more than 300 people congregate in one area. 2. Use Group E with an occupant load greater than 250. 3. Use Group B used for college or adult education with an occupant load grater than 500. 4. Use Group I-2 with an occupant load greater than 50, not having surgery or emergency treatment facilities. 5. Use Group I-3 6. Power generating stations and other public utility facilities not included in Seismic Hazard Exposure Group III 7. Any other occupancy with an occupancy load greater than 5,000
Group III Seismic Hazard Exposure Group III buildings are those having essential facilities which are required for post-earthquake recovery, including buildings containing any one ore more of the indicated occupancies.	1. Fire, rescue and police stations 2. Use Group I-2 having surgery or emergency treatment facilities. 3. Emergency preparedness centers 4. Post-earthquake recovery vehicle garages. 5. Power-generating stations and other utilities required as emergency backup facilities. 6. Primary communcation facilities. 7. High toxic materials as defined by 780 CMR 307.0 where the quantify of the material exceeds the exempt amounts of 780 CMR 307.8

1612.2.6 Group III building protected access: Where operational access to a Seismic Hazard Exposure Group III building is required through an adjacent building, the adjacent building shall conform to the requirements for Group III buildings. Where operational access is less than ten feet (30.48 m) from the interior lot line or another building on the same lot, protection from potential falling debris from adjacent property shall be provided by the owner of the Seismic Hazard Exposure Group III building.

1612.2.7 Seismic Performance Category: All buildings shall be assigned a Seismic Performance Category as follows;

Seismic Hazard Exposure Group (from Table 1612.2.5)	Seismic Performance Category
I	C
II	C
III	D

1612.3 Definitions: The following words and terms shall, for the purposes of 780 CMR 1612.0 and as used elsewhere in 780 CMR, have the meanings shown herein.

Acceleration:

Effective peak: Coefficient Aa, in accordance with 780 CMR 1612.2.3, for determining the prescribed seismic forces.

Effective peak velocity-related: Coefficient Av, in accordance with 780 CMR 1612.2.3, for determining the prescribed seismic forces.

Base: The level at which the horizontal seismic ground motions are considered to be imparted to the building.

Base shear: Total design lateral force or shear at the base of the building.

Bay (part of a structure): The space between two adjacent piers or mullions or between two adjacent lines of columns.

Design earthquake: The earthquake that produces ground motions at the site under consideration which has a 90% probability of not being exceeded in 50 years.

Designated seismic systems: The seismic-resisting system and those architectural, electrical and mechanical systems and their components that require special performance characteristics.

Diaphragm: A horizontal, or nearly horizontal, portion of the seismic-resisting system, which is designed to transmit seismic forces to the vertical elements of the seismic-resisting system.

Frame:

Braced: An essentially vertical truss, or its equivalent, of the concentric or eccentric type that is provided in a loadbearing wall, building frame or dual system to resist seismic forces.

Concentrically braced frame (CBF): A braced frame in which the members are subjected primarily to axial forces.

Eccentrically braced frame (EBF): A diagonally braced steel frame in which at least one end of each brace frames into a beam a short distance from a beam-column joint or from another diagonal brace. These short beam segments are called link beams. The following EBF definitions apply:

Diagonal brace: A member of an EBF placed diagonally in the bay of the frame.

Lateral support members: Secondary members designed to transmit seismic-resisting system.

Link beam: The horizontal beam in an EBF which has a length of the clear distance between the diagonal braces or between the diagonal brace and the column face.

Link beam end web stiffeners: Vertical web stiffeners placed on the sides of the web at the diagonal brace end(s) of the link beam.

Link beam intermediate web stiffener: Vertical web stiffeners placed within the link beam.

Link beam rotation angle: The angle between the beam outside of the link beam and the link beam occurring at a total story drift of the deflection amplification factor (C_d) times the elastic drift at the prescribed design forces. The rotation angle is permitted to be computed assuming the EBF bay is deformed as a rigid, ideally plastic mechanism.

Intermediate moment frame: A frame in which members and joints are capable of resisting forces by flexure as well as along the axis of the members. Intermediate moment frames of reinforced concrete shall conform to 780 CMR 1903.3.2.

Ordinary moment frame: A frame in which members and joints are capable of resisting forces by flexure as well as along the axis of the members.

Space frame: A structural system composed of interconnected members, other than loadbearing walls, that is capable of supporting vertical *loads* and, if so designed, resist the seismic forces.

Special moment frame: A frame in which members and joints are capable of resisting forces by flexure as well as along the axis of the members. Special moment frames shall conform to the applicable requirements of 780 CMR 1903.0 or 2204.0.

Frame system:

Building: A structural system with an essentially complete space frame providing support for vertical *loads*. Seismic force resistance is provided by shear walls or braced frames.

Dual: A structural system with an essentially complete space frame providing support for vertical *loads*. A moment-resisting frame shall be provided which shall be capable of resisting at least 25% of the prescribed seismic forces. The total seismic force resistance is provided by the combination of the moment-resisting frame together with shear walls or braced frames in proportion to their relative rigidities.

Moment resisting: A structural system with an essentially complete space frame providing support for vertical *loads*. Seismic force resistance is provided by special, intermediate or ordinary moment frames capable of resisting the total prescribed forces.

High-temperature energy source: A fluid, gas or vapor whose temperature exceeds 220°F (104°C).

Inverted pendulum-type structures: Structures that have a large portion of their mass concentrated near the top and thus have essentially one degree of freedom in horizontal translation. The structures are usually T-shaped with a single column supporting the beams or slab at the top.

Light-framed wall with shear panels: Wood or steel stud walls with finishes other than masonry veneer. Loadbearing wall system: A structural system with loadbearing walls providing support for all, or major portions of, the vertical *loads*. Shear walls or braced frames provide seismic force resistance.

P-Delta effect: The secondary effect on shears and moments of frame members due to the action of the vertical *loads* induced by displacement of the building frame resulting from lateral forces.

Resilient stable-mounting system: A system incorporating helical springs, air cushions, rubber-in-shear mounts, fiber-in-shear mounts, or other comparable approved systems. The force displacement ratios are equal in the horizontal and vertical directions

Restraining device: A device used to limit the vertical or horizontal movement of the mounting system due to earthquake motions.

Elastic: A fixed restraining device that incorporates an elastic element to reduce the seismic forces transmitted to the structure due to impact from the resilient mounting system.

Fixed: A nonyielding or rigid type of restraining device.

Seismic activated: An interactive restraining device that is activated by earthquake motion.

Seismic-resisting system: That part of the structural system that has been considered in the design to provide the required resistance to the seismic forces prescribed herein.

Shear wall: A wall, loadbearing or nonloadbearing, designed to resist seismic forces, from other than its own mass, acting in the plane of the wall.

Story drift ratio: The story drift divided by the story height.

Story shear: The summation of design lateral forces at levels above the story under consideration.

1612.4 Structural design requirements:

1612.4.1 Design Basis: The seismic analysis and design procedures utilized in the design of buildings and their structural components shall be in accordance with the requirements of 780 CMR 1612.4. The design seismic forces and their distribution over the height of the building shall be in accordance with the procedures in 780 CMR 1612.5 or 1612.6. The corresponding internal forces in the structural components of the building shall be determined using a linearly elastic model.

An alternate procedure using structural concepts other than as specified in this section may be used, if approved by the building offical, to establish the design forces and their distribution. Such an alternate procedure may be permitted where evidence is submitted to the building official showing that equivalent ductility and energy dissipation are provided, and the corresponding internal forces and deformations in the structural components are determined using a model consistent with the approved procedure.

Individual structural members shall be designed for the shear forces, axial forces and moments determined in accordance with 780 CMR 1612.4. Connections shall be designed to develop the strength of the connected members or the analysis force, whichever is less. The design story drift of the building, calculated as specified herein, shall not exceed the allowable story drift of 780 CMR 1612.4.8, when the building is subjected to the design seismic forces.

A continuous load path, or paths, with adequate strength and stiffness shall be provided to transfer all forces from the point of application to the final point of resistance. The foundation shall be designed to resist the forces developed and shall accomodate the movements imparted to the building by the design ground motions. The foundation design criteria shall account for the dynamic nature of the seismic forces, the design ground motions and the design basis for strength and ductility of the structure.

Consideration shall be given to the manner in which the earthquake lateral force, computed in accordance with 780 CMR 1612.5 or 1612.6 will be transmitted from the soil or rock to the structure. Transmission of the lateral force will occur through one or more of the following foundation elements:

a. Lateral soil pressure against foundation walls, footings, grade beams and pile caps;

b. Lateral soil pressure against piles, piers or caissons;

c. Side or bottom friction on walls, footings or mats or;

d. Batter piles.

Bottom friction under pile caps shall be assumed to be ineffective in transmitting horizontal forces.

The horizontal force shall be distributed among the various elements in the foundation in proportion to their estimated rigidities. Any element which will participate in the transfer of horizontal forces from the soil to the structure shall be designed to resist forces in such a way that its ability to sustain static load will not be impaired.

1612.4.2 Site coefficient: The value of the site coefficient (S) shall be determined from Table 1612.4.1. In locations where the soil properties are not known in sufficient detail to determine the soil-profile type or where the soil profile does not fit any of the four types indicated in Table 1612.4.1, a site coefficient (S) of 1.5 shall be used. For determination of Site Coefficient, all soil and rock below the final ground surface shall be considered.

When a structure is located on soil deposits meeting the criteria for two or more site coefficient values, the largest applicable value shall be used.

Table 1612.4.1
SITE COEFFICIENT

Soil-profile type	Description[a,b]	Site Coefficient S
S_1	A profile consisting of: Rock of Material Classes 1 through 4, or; Rock of any characteristic, either shale-like or crystalline in nature, which has a shear wave velocity greater than 2,500 feet per second, or; Stiff soil conditions where the soil depth is less than 200 feet and the soil types overlying rock are stable deposits of weathered bedrock of Material Class 5; dense to very dense till, gravel or sand and gravel of Materials Classes 6 and 7; dense to very dense sand of Material Classes 8 and 9; dense inorganic silt of Material Class 9; stiff to hard clay of Material Class 10 with undrained shear strength of 2,000 pounds per square foot or greater, or; compacted granular fills provided that the fill soils are compacted throughout as required in 780 CMR 1804.1	1.0
S_2	A soil profile meeting the requirements for S_1 except the soil depth exceeds 200 feet; or a soil profile which contains up to 40 feet of medium stiff clay (Material Class 10), with undrained shear strength of 1,000 pounds per square foot or greater; or a soil profile which contains up to 40 feet of medium dense gravel, sand and/or silt (Material Classes 7 through 10), that is not susceptible to liquefaction in accordance with 780 CMR 1802.2	1.2
S_3	A soil profile containing 40 to 100 feet in thickness of medium stiff clay (Material Class 10) with undrained shear strength of 1,000 pounds per square foot or greater, with or without intervening layers of granular soils; or up to 40 feet of soft clay (Material Class 10) with undrained shear strength of less than 1,000 pounds per square foot; or up to 40 feet of very loose to loose gravel, sand or silt (Material Classes 7 through 9); or up to 20 feet of organic soil (Material Class 11) or loose or soft fill which was not placed in accordance with 780 CMR 1804.1	1.5
S_4	A soil profile containing more than 100 feet of medium stiff clay (Material Class 10) with undrained shear strength of 1,000 pounds per square foot or greater, with or without intervening layers of granular soils; or more than 40 feet of soft clay (Material Class 10) with undrained shear strength of less than 1,000 pounds per square foot; or more than 40 feet of very loose to loose sand or silt (Material Classes 8 and 9); or more than 20 feet of organic soil (Material Class 11); or more than 20 feet of loose or soft fill which was not placed in accordance with 780 CMR 1804.1; or more than 20 feet of soils of any type having a shear wave velocity of 500 feet per second or less.	2.0

Notes:

a) 1 foot = 304.8 mm

b) See appendix G for guidance in selecting Material Classes

1612.4.3 Soil-structure interaction: The design base shear, story shears, overturning moments and deflections determined by the requirements of 780 CMR 1612.5 or 1612.6 are permitted to be modified in accordance with approved procedures which account for the effects of soil-structure interaction.

1612.4.4 Structural framing systems: The basic structural framing systems to be utilized are indicated in Table 1612.4.4. Each type is subdivided by the types of vertical structural elements that will resist the design lateral forces. The structural system utilized shall be in accordance with the seismic performance category and height limitations indicated in Table 1612.4.4. The appropriate response modification factor (R) and the deflection amplification factor (C_d) indicated in Table 1612.4.4 shall be utilized in determining the base shear and the design story drift. Structural framing and seismic-resisting systems which are not contained in Table 1612.4.4 shall be permitted if analysis and test data are submitted that establish the dynamic characteristics and demonstrate the lateral force resistance and energy dissipation capacity to be equivalent to the structural systems listed in Table 1612.4.4 for equivalent response modification factor (R) values.

1612.4.4.1 Dual system: For a dual system, the moment frame shall be capable of resisting at least 25% of the design seismic forces. The total seismic force resistance is to be provided by the combination of the moment frame and the seismic-resisting elements in proportion to their rigidities.

1612.4.4.2 Combinations of framing systems: Different structural framing systems are permitted along the two orthogonal axes of the building. Combinations of framing systems shall comply with the requirements of 780 CMR 1612.4.4.2.1 and 1612.4.4.2.2

1612.4.4.2.1 Combination framing factor (R): The response modification factor (R) in the direction under consideration at any story shall not exceed the lowest response modification factor (R) obtained from Table 1612.4.4 or the seismic-resisting system in the same direction considered above that story.

Exception: Supported structural systems with weight equal to or less than 10% of the weight of the building are not required to comply with 780 CMR 1612.4.4.2.1.

1612.4.4.2.2 Combination framing detailing requirements: The detailing requirements of 780 CMR 1612.4.7 required by the higher response modification factor (R) shall apply to structural components common to systems having different response modification factors.

1612.4.4.3 Seismic Performance Category C: The structural framing system for buildings assigned to Seismic Performance Category C shall comply with the building height and structural system limitations in Table 1612.4.4.

1612.4.4.4 Seismic Performance Category D: The structural framing system for buildings assigned to Seismic Performance Category D shall comply with 780 CMR 1612.4.4.3 and the additional provisions of 780 CMR 1612.4.4.

1612.4.4.4.1 Limited building height: Buildings having a structural system of steel or cast-in-place concrete-braced frames or shear walls are limited to a height of 240 feet (73.15 m) where there are braced frames or shear walls so arranged that braced frames or shear walls in one plane resist not more than the following proportion of the seismic design force in each direction, including torsional effects:

1. 60% where the braced frame or shear walls are arranged only on the perimeter;
2. 40% where some of the braced frames or shear walls are arranged on the perimeter; or
3. 30% for other arrangements.

1612.4.4.4.2 Interaction effects: Moment-resisting frames that are enclosed or adjoined by more rigid elements not considered to be part of the seismic-resisting system shall be designed so that the action or failure of the enclosing or adjoining elements will not impair the vertical load and seismic force-resisting capability of the frame. The design shall provide for the effect of these rigid elements on the structural system at building deformations corresponding to the design story drift (delta) as determined in 780 CMR 1612.5.5

TABLE 1612.4.4[(a)]

Structural Systems

Basic Structural system	Response Modification Factor (R)	Deflection Amplification Factor (Cd)	Structural system limitations and building height (feet) limitations (see Note b)	
			Seismic Performace Category	
Seismic Resisting System			C	D
1. Loadbearing wall system Light-framed walls with shear panels	6½	4	Not limited	160
Reinforced concrete shear walls	4 ½	4	Not limited	160
Reinforced masonry shear walls	3½	3	Not limited	160
Concentrically braced frames	3½	3½	Not limited	160
Unreinforced masonry shear walls	1¼	1¼	Not permitted	Not permitted
Plain concrete shear walls	1½	1½	Not permitted	Not permitted
2. Building Frame System				
Eccentrically braced frames, moment resisting connections at columns away from link beam	8	4	Not limited	160
Eccentrically braced frames nonmoment-resisting connections at columns away from link beam	7	4	Not limited	160
Light-framed walls with shear panels	7	4½	Not limited	160
Concentrically braced frames	5	4½	Not limited	160
Reinforced concrete shear walls	5½	5	Not limited	160
Reinforced masonry shear walls	4½	4	Not limited	160
Unreinforced masonry shear walls	1½	1½	Not permitted	Not permitted
Plain concrete shear walls	2	2	Not permitted	Not permitted
3. Moment-resisting frame system				
Special moment frames of steel	8	5½	Not limted	Not limited
Special moment frames of reinforced concrete	8	5½	Not limited	Not limited
Intermediate moment frames of reinforced concrete	5	4½	Not limited	Not permitted
Ordinary moment frames of steel	4½	4	Not limited	160
Ordinary moment frame of reinforced concrete	3	2½	Not permitted	Not permitted
4. Dual system with a special moment frame capable of resisting at least 25% of the prescribed seismic forces Eccentrically braced frames, moment-resisting connections at columns away from link beam	8	4	Not limited	Not limited
Eccentrically braced frames, nonmoment-resisting connections at columns away from link beam	7	4	Not limited	Not limited
Concentrically braced frames	6	5	Not limited	Not limited
Reinforced concrete shear walls	8	6½	Not limited	Not limited
Reinforced masonry shear walls	6½	5½	Not limited	Not limited
Wood-sheathed shear walls	8	5	Not limited	Not limited
5. Dual system with an intermediate moment frame of reinforced concrete or an ordinary moment frame of steel capable of resisting at least 25% of the prescribed seismic forces				
Concentrically braced frames	5	4½	Not limited	160
Reinforced concrete shear walls	6	5	Not limited	160
Reinforced masonry shear walls	5	4½	Not limited	160
Wood-sheathed shear walls	7	4½	Not limited	160
6. Inverted Pendulum structures Special moment frames of structural steel	2½	2½	Not limited	Not lmiited
Special moment frames of reinforced concrete	2½	2½	Not limited	Not lmited
Ordinary moment frames of structural steel	1¼	1¼	Not limited	Not permitted

Note a. Response modification factor(R) for application of 780 CMR 1612.5 and 1612.6: Deflection amplificaton factor (Cd) for application of 780 CMR 1612.5 and 1612.6.

Note b. The building height shall not exceed the general height limitation of 780 CMR 503.0 and 502.0 based on the type of construction

Note c. See 780 CMR 1612.4.4.4.1for description of building systems which are limited to buildings with a height of 240 feet or less.

Note d. See 780 CMR 1612.4.4.5 for description of building systems which are limited to buildings with a height of 160 feet or less.

1612.4.4.3.3 Deformational compatibility: Every structural component not included in the seismic force-resisting system in the direction under consideration shall be designed to be adequate for the vertical load-bearing capacity and the induced moments resulting from the design story drift (Δ) as determined in accordance with 780 CMR 1612.5.5 (see also 780 CMR 1612.4.8)

1612.4.4.4.4 Special moment frames: A special moment frame that is utilized but not required by Table 1612.4.4 is permitted to be discontinuous and supported by a more rigid system with a lower response modification factor (R) provided that the requirements of 780 CMR 1612.4.7.2.4 and 1612.4.7.4.2 are met. Where a special moment frame is required by Table 1612.4.4, the frame shall be continuous to the foundation.

1612.4.5 Building configuration: Buildings shall be classified as regular or irregular based on the plan and vertical configuration.

1612.4.5.1 Plan irregularity: Buildings having one or more of the features listed in Table 1612.4.5.1 shall be designated as having plan irregularity and shall comply with the requirements in the referenced code sections of Table 1612.4.5.1.

1612.4.5.2 Vertical irregularity: Buildings having one or more of the features listed in Table 1612.4.5.2 shall be designated as having vertical irregularity and shall comply with the requirements in the referenced code sections of Table 1612.4.5.2.

Exceptions:

1. Structural irregularities of Type 1 or 2 in Table 1612.4.5.2 do not apply where the building story drift ratio is less than 130% of the story drift ratio of the next story above. Torsional effects are not required to be considered in the calculation of story drifts. The story drift ratio relationship for the top two stories of the building is not required to be evaluated.
2. IrregularityTypes 1 and 2 of Table 1612.4.5.2 are not required to be considered for one- and two-story buildings.

Table 1612.4.5.1
PLAN STRUCTURAL IRREGULARITIES

Irregularity type and description	Referenced Section	Seismic Performance Category Application
1 Torsional irregularity --- to be considered where diaphragms are rigid in relation to the vertical structural elements which resist the lateral seismic forces.	780 CMR 1612.4.7.4.2	D
Torsional irregularity shall be considered to exist where the maxixmum story drift computed, including accidental torsion, at one end of the structure transverse to an axis is more than 1.2 times the average of the story drifts at the two ends of the structure.	780 CMR 1612.5.3.1	C and D
2 Re-entrant corners Plan configurations of a structure and its lateral force-resisting system contain re-entrant corners, where both projections of the structure beyond a re-entrant corner are greater than 15% of the plan dimension of the structure in the given direction.	780 CMR 1612.4.7.4.2	D
3 Diaphragm discontinuity Diaphragms with abrupt discontinuities or variations in stiffness, including those having cutout or open areas greater than 50% of the gross enclosed area of diaphragm, or changes in effective diaphragm stiffness of more than 50% from one story to the next.	780 CMR 1612.4.7.4.2	D
4 Out-of-plane vertical element offsets Discontinuities in a lateral force-resistance path, such as out-of-plane offsets of the vertical elements which resist the lateral seismic forces.	780 CMR 1612.4.7.4.2	D
5 Nonparallel systems The vertical lateral force-resisting elements are not parallel to, or are not symmetric about, the major orthogonal axes of the lateral force-resisting system.	780 CMR 1612.4.7.3.1	C and D

Table 1612.4.5.2
VERTICAL STRUCTURAL IRREGULARITIES

Irregularity type and description	Referenced Section	Seismic Performance Category Application
1 Stiffness irregularity --- soft story. A soft story is one in which the lateral stiffness is less than 70% of that in the story above or less than 80% of the average stiffness of the three stories above.	780 CMR 1612.4.6.2	D
2 Weight (mass) irregularity Mass irregularity shall be considered to exist where the effective masss of any story is more than 150% of the effective mass of an adjacent story. A roof that is lighter than the floor below is not required to be considered.	780 CMR 1612.4.6.2	D
3 Vertical geometric irregularity Vertical geometric irregularity shall be considered to exist where the horizontal dimension of the lateral force-resisting system in any story is more than 130% of that in an adjacent story.	780 CMR 1612.4.6.2	D
4 In-plane discontinuity in vertical lateral force-resisting elements. An in-plane offset of the lateral force-resisting elements greater than the length of those elements.	780 CMR 1612.4.7.4.2	D
5 Discontinuity in capacity --- weak story A weak story is one in which the story lateral strength is less than 80% of that in the story above. The story strength is the total strength of all seismic resisting elements sharing the story shear for the direction under consideration.	780 CMR 1612.4.7.2.4	C and D

1612.4.6 Analysis procedures: A structural analysis shall be made for all buildings in accordance with the requirements of 780 CMR 1612.4.6. An alternative generally accepted procedure, including utilization of a site-specific response spectrum, is permitted, where approved by the code official. The limitations on the base shear in 780 CMR 1612.6 apply to dynamic modal analysis. When this alternative is used, the site specific response spectrum shall be considered in the required peer review.

1612.4.6.1 Seismic Performance Category C: Regular or irregular buildings assigned to Category C shall be analyzed in accordance with the procedures in 780 CMR 1612.5.

1612.4.6.2 Seismic Performance Category D: Buildings assigned to Seismic Performance Category D shall be analyzed in accordance with the referenced sections in Table 1612.4.6.2.

Table 1612.4.6.2
ANALYSIS PROCEDURES FOR SEISMIC PERFORMANCE CATEGORY D

Building Description	Referenced Section and Procedures
1 Buildings designated as regular which do not exceed 240 feet in height.	780 CMR 1612.5
2 Buildings that have only vertical irregularities of Type 1, 2 or 3 in table 1612.4.5.2 and have a height exceeding five stories or 65 feet, and all buildings exceeding 240 feet in height.	780 CMR 1612.6
3 All other buildings designated as having plan or vertical irregularities in accordance with tables 1612.4.5.1 and 1612.4.5.2	780 CMR 1612.5 or 780 CMR 1612.6

1612.4.7 Design, detailing requirements and structural component load effects: The design and detailing of structural components of the seismic-resisting system shall comply with the requirements of 780 CMR 1612.4. Foundation design shall conform to the applicable requirements of 780 CMR 18.

1612.4.7.1 Seismic Performance Category A: The design and detailing of buildings assigned to Seismic Performance Category A shall comply with the requirements of 780 CMR 1612.4.7.1.

1612.4.7.1.1 Ties and continuity: Except for connections exempted by 780 CMR 1612.7, all parts of the building that transmit seismic force shall be interconnected to form a continuous path to the building's seismic-resisting system. Any smaller portion of the building shall be tied to the remainder of the building with elements having a strength capable of transmitting the seismic force (F_p) determined in accordance with 780 CMR 1612.7, but not less than one-third of the effective peak velocity-related acceleration (A_v) times the weight of the smaller portion (W_c) or 5% of the portion's weight. whichever is greater. For a building which is exempt from a full seismic analysis by 780 CMR 1612.2 and is only required to comply with 780 CMR 1612.4.7.1, the building's main windforce-resisting system in accordance with 780 CMR 1611.0 shall be deemed to be the seismic-resisting system. A positive connection for resisting a horizontal force acting parallel to the member shall be provided for each beam, girder or truss to its support. The connection shall have a minimum strength of 5% of the dead plus *live load* reaction.

1612.4.7.1.2 Concrete or masonry wall anchorage: Concrete and masonry walls shall be anchored to the roof and all floors that provide lateral support for the wall. The anchorage shall provide a direct connection between the walls and the roof or floor construction. Toe nailing or nails subject to withdrawal forces is not permitted. Wood ledgers shall not be subjected to cross-grain bending or cross-grain tension. The connections shall be capable of resisting a lateral seismic force (F_p) in accordance with either 780 CMR 1612.4.7.2.8 or 780 CMR 1612.7, for loadbearing and nonloadbearing walls respectively, but not less than 1,000 times the effective peak velocity-related acceleration (A_v) (pounds) per lineal foot of wall. Walls shall be designed to resist bending between anchors where the anchor spacing exceeds four feet (1.22 m).

1612.4.7.2 Seismic Performance Category B: Buildings assigned to Category B shall conform to the requirements of 780 CMR 1612.4.7.1 for Category A and the requirements of 780 CMR 1612.4.7.2.

1612.4.7.2.1 Component Load Effects: Seismic load effects on components shall be detemined from the load analysis as required by 780 CMR 1612.4.6, by other portions of 780 CMR 1612.4.7.2, and by 780 CMR 1616. The second order effects shall be included where applicable. Where these seismic load effects exceed the minimum load path connection forces given in 780 CMR 1612.4.7.1.1 and 1612.4.7.2.2, they shall govern.

1612.4.7.2.2 Openings: Where openings occur in shear walls, diaphragms or other plate-type elements, the edges of the openings shall be designed to transfer the stresses into the structure. The edge reinforcement shall extend into the body of the wall or diaphragm a distance sufficient to develop the stress of the edge reinforcement member.

1612.4.7.2.3 Orthogonal effects: The design seismic forces shall be applied separately, and independently, in each of two orthogonal directions.

1612.4.7.2.4 Discontinuities in vertical system: Buildings with a discontinuity in lateral capacity, vertical irregularity Type 5 as defined in Table 1612.4.5.2, shall not be more than two stories or 30 feet (9.14 m) in height where the "weak" story has a calculated strength of less than 65% of the storey above.

Exception: Where the "weak" story is capable of resisting a total seismic force equal to 75% of the deflection application factor (Cd) times the design force prescribed in 780 CMR 1612.5.

1612.4.7.2.5 Nonredundant systems: The building design shall comply with 780 CMR 1604.2.

1612.4.7.2.6 Collector elements: Collector elements shall be provided which are capable of transferring the seismic forces originating in other portions of the building to the element providing the resistance to those forces.

1612.4.7.2.7 Diaphragms: The deflection in the plane of the diaphragm. as determined by engineering analysis, shall not exceed the allowable deflection of the attached elements. Allowable deflection shall be that deflection which will permit the attached element to maintain its structural integrity under the individual loading and continue to support the prescribed *loads*.

Floor and roof diaphragms shall be designed to resist the following seismic forces: a minimum force equal to 50% the effective peak velocity-related acceleration (A_v) times the weight of the diaphragm and other elements of the building attached thereto, plus the portion of the seismic shear force at that level (V_x) required to be transferred to the components of the vertical seismic-resisting system because of offsets or changes in stiffness of the vertical components above and below the diaphragm.

Diaphragms shall provide for both the shear and bending stresses resulting from these forces. Diaphragms shall have ties or struts to distribute the wall anchorage forces into the diaphragm. Connections within diaphragms, connections of diaphragms to lateral load resisting elements, and connections of collectors such as ties and struts, to the diaphragm and vertical elements, shall be positive connections, mechanical or welded.

1612.4.7.2.8 Loadbearing walls: Exterior and interior loadbearing walls and their anchorage shall bc designed for a force of the effective peak velocity-related acceleration (A_v) times the weight of wall, normal to the surface, with a minimum force of 10% of the weight of the wall. Interconnection of wall elements and connections to supporting framing systems shall have sufficient ductility, rotational capacity or sufficient strength to resist shrinkage, thermal changes and differential foundation settlement where combined with seismic forces. The connections shall also satisfy 780 CMR 1612.4.7.1.2

1612.4.7.2.9 Inverted pendulum-type structures: Supporting columns or piers of inverted pendulum-type structures shall be designed for the bending moment calculated at the base determined by the procedures given in 780 CMR 1612.5 and shall vary uniformly to a moment at the top equal to one-half the calculated bending moment at the base.

1612.4.7.2.10 Anchorage of Nonstructural Systems: When required by 780 CMR 1612.7, all portions or components of the building shall be anchored for the seismic force (Fp) prescribed therein.

1612.4.7.3 Seismic Performance Category C: Buildings assigned to Category C shall conform to the requirements of 780 CMR 1612.4.7.2 for Category B and the requirements of 780 CMR 1612.4.7.3.

1612.4.7.3.1 Plan irregularity: Buildings that have plan structural irregularity Type 5 in Table 1612.4.5.1 shall be analyzed for the critical *load* effect due to direction of application of seismic forces. Alternatively, the building shall be analyzed in any two orthogonal directions. Structural elements and foundations shall be designed for 100% of the forces for one direction plus a simultaneous load of 30% of the forces for the perpendicular direction, except where the amplified seismic load effects of 780 CMR 1616.4 are used.

1612.4.7.4 Seismic Performance Category D: Buildings assigned to Category D shall conform to the requirements of 780 CMR 1612.4.7.3 for Category C and to the requirements of 780 CMR 1612.4.7.4.

1612.4.7.4.1 Orthogonal load effects: Buildings shall be designed for 100% of the seismic forces for one direction plus a simultaneous *load* of 30% of the seismic forces for the perpendicular direction. The load combination requiring the maximum structural component strength shall be used.

Exception: Where amplified seismic load effects of 780 CMR 1616.4 are used, the building may be designed for the load effects based on analyses in any two orthogonal directions. Diaphragms and components of the seismic-resisting system utilized in only one of the two orthogonal directions are not required to be designed for the combined *load* effects.

1612.4.7.4.2 Plan or vertical irregularities: For buildings having a plan irregularity of Type 1, 2, 3 or 4 in Table 1612.4.5.1 or a vertical irregularity of Type 4 in Table 1612.4.5.2, the design forces determined from 780 CMR 1612.5 shall be increased 25% for connections of diaphragms to vertical elements and to collectors and for connections of collectors to the vertical elements.

1612.4.7.4.3 Vertical seismic loads: The vertical component of earthquake ground motion shall be accounted for in the design of horizontal cantilever and horizontal prestressed components. Horizontal prestressed components shall be designed for load combination #8 of 780 CMR 1616.3.1, including the amplified seismic effects of 780 CMR 1616.4. Horizontal cantilever structural components shall be designed for a net upward force of 0.2 times the *dead load*, as a separate loading case, in addition to the applicable load combinations of 780 CMR 1616.

1612.4.8 Deflection and drift limits: The design story drift (Δ) as determined in 780 CMR 1612.5.5 or 1612.6.8, shall not exceed the allowable story drift (Δ_a) from Table 1612.4.8 for any story. For structures with significant torsional deflections, the maximum drift shall include torsional effects. The total deflection of a building due to seismic design forces shall not encroach on an interior lot line. All portions of the building shall be designed and constructed to act as an integral unit in resisting seismic forces unless separated structurally by a distance sufficient to avoid contact causing damage to the structural system of the building under total deflection (δ_x) as determined by 780 CMR 1612.5.5.1.

1612.4.9 Foundation walls and retaining walls: Exterior foundation walls and retaining walls shall be designed to resist at least the superimposed effects of the total static lateral soil pressure, excluding the pressure caused by any temporary surcharge, plus and earthquake force of $0.045Y_t H^2$ for horizontal backfill surface. Where Y_t is the total unit weight of the soil and H is the height of the wall measured as the difference in elevation of finished ground surface (or floor) in front of and behind the wall. Surcharges which are applied over extended periods of time shall be included in the total static lateral soil pressure and their earthqake lateral force shall be computed and added to the force of $0.045Y_t H^2$. The earthquake force from the backfill shall be distributed as an inverse triangle over the height of the wall. The point of application of the earthquake force from an extended duration surcharge shall be determined on an individual case basis. If the backfill consists of loose saturated granular soil, consideration shall be given to the potential increase in lateral pressure due to liquefaction of the backfill during the seismic loading in accordance with 780 CMR 1805.2. For use in wall strength design, a load factor of 1.43 times the earthquake force calculated above shall be applied.

1612.5 Equivalent lateral force procedure: 780 CMR 1612.5 provides requirements for the equivalent lateral force procedure of seismic analysis of buildings. For purposes of analysis, the building is considered to be fixed at the base. See 780 CMR 1612.4.6 for limitations on the applicability of this procedure.

Table 1612.4.8
ALLOWABLE STORY DRIFT (Δ_a) [a]

Building	Seismic Hazard Exposure Group		
	I	II	III
One story buildings without equipment attached to the seismic-resisting structural system and with interior walls, partitions, ceilings and exterior wall systems which have been designed to accomodate the story drifts.	No Limit	0.020 h_{sx}	0.015 h_{sx}
Buildings having four stories or less with interior walls, partitions, ceilings and exterior wall systems which have been designed to accomodate the story drifts.	0.025 h_{sx}	0.020 h_{sx}	0.015 h_{sx}
All other buildings	0.020 h_{sx}	0.015 h_{sx}	0.010 h_{sx}

Note a: h_{sx} is the story height below level x

1612.5.1 Seismic base shear: The seismic base shear (V) in a given direction shall be determined in accordance with the following formula:

$$V = C_s W$$

where:

C_s = The seismic design coefficient determined in accordance with 780 CMR 1612.5.1.1.

W = The total *dead load* and applicable portions of other *loads* listed below:

1. For occupancies in Use Group S, a minimum of 25% of the floor *live load* shall be applicable.

   Exception: Floor *live load* in public garages and open parking structures is not applicable.

2. Where partitions will be present, whether or not partitions are shown on the *construction documents*, the actual partition weight or a minimum weight of 10 psf of floor area, whichever is greater, shall be applicable.
3. Total operating weight of permanent equipment.
4. Snow load reduction of 50% is permitted.

1612.5.1.1 Calculation of seismic coefficient (C_s): The seismic design coefficient (C_s) shall be determined in accordance with the following formulas:

$$C_s = \frac{1.2 A_v S}{R T^{2/3}}$$

where:

A_v = The coefficient representing effective peak velocity-related acceleration from 780 CMR 1612.2.3.

S = The coefficient for the soil-profile characteristics of the site in Table 1612.4.1.

R = The response modification factor in Table 1612.4.3.

T = The fundamental period of the building determined in 780 CMR 1612.5.1.2.

A soil-structure interaction reduction is permitted where determined from an approved procedure. Alternatively, the seismic design coefficient (C_s) is not required to be greater than the following equation:

$$C_s = \frac{2.5 A_a}{R}$$

where:

A_a = The seismic coefficient representing the effective peak acceleration as determined in 780 CMR 1612.2.3

R = The response modification factor in Table 1612.4.4

1612.5.1.2 Period determination: The fundamental period (T), in seconds, of the building, in the direction under consideration, shall be established based on the structural properties and deformational characteristics of the resisting elements in a properly substantiated analysis. The fundamental period (T) shall not exceed the product of the coefficient for the upper limit on calculated period (C_a) from Table 1612.5.1.2, and the approximate fundamental period (T_a).

Alternatively, the fundamental period (T) shall be determined from 780 CMR 1612.5.1.2.1.

Table 1612.5.1.2
COEFFICIENT FOR UPPER LIMIT ON CALCULATED PERIOD (C_a)

Av Coefficient representing effective peak velocity related acceleration	Ca
0.12	1.6

1612.5.1.2.1 Approximate fundamental period (T_a): The approximate fundamental period (T_a), in seconds, shall be determined from the following formula:

$$T_a = C_T H_n^{3/4}$$

where:

h_n = The height (in feet) from the base to the highest level of the building.

C_T = 0.035 For moment-resisting frame systems of steel which provide 100% of the required lateral force resistance, where the frame is not enclosed or adjoined by more rigid components.

C_T = 0.03 For moment-resisting frame systems of concrete which provide 100% of the required lateral force resistance, where the frame is not enclosed or adjoined by more rigid components.

C_T = 0.03 For building frame systems with an eccentrically braced steel frame or dual systems with an eccentrically braced frame.

C_T = 0.02 For seismic-resisting systems with shear walls, shear panels or concentrically braced frames and all other building systems.

Alternatively, the approximate fundamental period (T_a), in seconds, shall be determined from the following formula for buildings in which the lateral force-resisting system consists of concrete or steel moment-resisting frames capable of resisting 100% of the required lateral force and where such frames are not enclosed or adjoined by more rigid components tending to prevent the frames from deflecting when subjected to seismic forces. Such buildings shall not exceed 12 stories in height and shall have a story height of not less than ten feet (3048 mm).

$$T_s = 0.1N$$

where:

N = Number of stories.

1612.5.2 Vertical distribution of seismic forces: The lateral force (F_x) induced at any level shall be determined from the following formulas:

$$F_x = C_{vx} V$$

$$C_{vx} = \frac{w_x h_x^k}{\sum_{i=1}^{n} w_i h_i^k}$$

where:

C_{vx} = Vertical distribution factor

V = Total design lateral force or shear at the base of the building

w_i and w_x = the portion of the total gravity load of the building (W) located or assigned to level i or x

h_i and h_x = the height (in feet) from the base to level i or x

k = An exponent related to the building period as follows;

For buildings having a period of 0.5 seconds or less, k=1.

For buildings having a period of 2.5 seconds or more, k=2

For buildings having a period between 0.5 and 2.5 seconds, k shall be 2 or shall be determined by linear interoplation between 1 and 2.

1612.5.3 Horizontal shear distribution: The seismic design story shear in any story (V_x) shall be determined from the following formula:

$$V_x = \sum_{i=x}^{n} F_i$$

where:

F_i = the portion of the seismic base shear (V) induced at level i.

The seismic design story shear (V_x) shall be distributed to the various vertical elements of the seismic-resisting system in the story under consideration based on the relative lateral stiffness of the vertical resisting elements and the diaphragm.

1612.5.3.1 Torsion: The design shall include the torsional moment (M_t) resulting from the location of the building masses plus the accidental torsional moments (M_{ta}) caused by assumed displacement of the mass each way from its actual location by a distance equal to 5% of the dimension of the building perpendicular to the direction of the applied forces.

In buildings of Seismic Performance Categories C, D and E, where Type 1 torsional irregularity exists as defined in Table 1612.4.5.1, the effects shall be accounted for by increasing the accidental torsion at each level by a torsional amplification factor (A_x) determined from the following formula:

$$A_x = \left[\frac{\delta_{max}}{1.2\delta_{avg}}\right]^2$$

where:

δ_{max} = the maximum displacment at level x.

δ_{avg} = the average of the displacments at the extreme points of the structure at level x.

The torsional amplification factor (A_x) is not required to exceed 3.0.

1612.5.4 Overturning: The building shall be designed to resist overturning effects caused by the seismic forces determined in 780 CMR 1612.5.2. At any story, the increment of overturning moment in the story under consideration shall be distributed to the various vertical resisting elements in the same proportion as the distribution of the horizontal shears to those elements.

The overturning moments at level x (M_x) shall be determined from the following formula:

$$M_x = \tau \sum_{i=x}^{n} F_i(h_i - h_x)$$

where:

F_i = The portion of the seismic base shear (V) induced at level i.

h_i and h_x = The height (in feet) from the base to level i or x.

τ = 1.0 for the top ten stories;
0.8 for the 20th story from the top and below; and
a value between 1.0 and 0.8 determined by a straight line interpolation for stories between the tenth and 20th stories below the top.

The foundations of buildings, except inverted pendulum structures, shall be designed for the foundation overturning design moment (M_f) at the foundation-soil interface determined by the equation for the overturning moment at level x (M_x) with an overturning moment reduction factor (τ) of 0.75 for all building heights.

1612.5.5 Drift determination and P-delta effects: Story drifts and, where required, member forces and moments due to P-delta effects, shall be determined in accordance with 780 CMR 1612.5.5.1 and 1612.5.5.2.

1612.5.5.1 Story drift determination: The design story drift (Δ) shall be computed as the difference of the deflections at the top and bottom of the story under consideration. The deflections of level x at the center of the mass (δ_x) shall be determined in accordance with the following formula:

$$\delta_x = C_d \delta_{xe}$$

where:

C_d = The deflection amplification factor in Table 1612.4.4.

δ_{xe} = The deflections determined by an elastic analysis.

The elastic analysis of the seismic-resisting system shall be made utilizing the required seismic design forces of 780 CMR 1612.5.2.

For determining compliance with the story drift limitation of 780 CMR 1612.4.8, the deflection of level x at the center of mass (δ_x) shall be calculated as required in this section. For the purposes of this drift analysis only, the computed fundamental period (T) of the building is not required to include the upper bond limitation specified in 780 CMR 1612.5.1.2 when determining drift level seismic design forces.

Where applicable, the design story drift (Δ) shall be increased by the incremental factor relating to the P-delta effects as determined in 780 CMR 1612.5.5.2.

1612.5.5.2 P-delta effects: P-delta effects on story shears and moments, the resulting member forces and moments, and the story drifts induced by these effects are not required to be considered where the stability coefficient (θ), as determined by the following formula, is equal to or less than 0.10:

$$\theta = \frac{P_x \Delta}{V_s h_{sx} C_d}$$

where:

P_x = The total vertical design load at story level x. In calculating the vertical design load for the purpose of determining P-delta effects, individual load factors are not required to exceed 1.0.

Δ = The design story drift occurring simultaneously with the story shear (V_x)

V_x = The seismic shear force between levels x and x-1.

h_{sx} = The story height below level x.

C_d = The deflection amplification factor in Table 1612.4.4

The stability coefficient (θ) shall not exceed θ_{max} determined as follows:

$$\theta_{max} = \frac{0.5}{\beta C_d} \leq 0.25$$

where:

β = The ratio of shear demand to shear capacity for the story between levels x and x-1. This ratio is permitted to be considered as 1.0.

Where the stability coefficient (θ) is greater than 0.10 but less than or equal to θ_{max}, the incremental factor related to P-delta effects shall be determined by rational analysis. To obtain the story drift for including the P-delta effect, the design story drift determined in 780 CMR 1612.5.5.1 shall be multiplied by $1.0/(1 - \theta)$.

1612.6 Modal analysis procedure: 780 CMR 1612.6 provides required standards for the modal analysis procedure of seismic analysis of buildings. 780 CMR 1612.4.6 specifies the limitations on the applicability of this procedure.

1612.6.1 General: The symbols in this method of analysis have the same meaning as those for similar terms used in 780 CMR 1612.5, with the subscript "m" denoting quantities in the mth mode.

1612.6.2 Modeling: The building shall be modeled as a system of masses lumped at the floor levels with each mass having one degree of freedom; lateral displacement in the direction under consideration.

1612.6.3 Modes: The analysis shall include, for each of two mutually perpendicular axes, at least the lowest three modes of vibration, or all modes of vibration with periods greater than 0.4 seconds, or sufficient modes to include 90% of the participating mass of the structure, whichever is greater. The number of modes shall equal the number of stories for buildings less than three stories in height.

1612.6.4 Periods: The required periods and mode shapes of the building in the direction under consideration shall be calculated by established methods of structural analysis for the fixed base condition utilizing the masses and elastic stiffnesses of the seismic-resisting system.

1612.6.5 Modal base shear: The portion of the base shear contributed by the mth mode (V_m) shall be determined from the following formula:

$$V_m = C_m W_m$$

where:

C_{sm} = The modal seismic design coefficient determined by the following formula.

W_m = The effective modal gravity load determined by the following formula.

$$W_m = \frac{\left[\sum_{i=1}^{n} W_i \theta_{im}\right]^2}{\sum_{i=1}^{n} W_i \theta^2 im}$$

where:

w_i = the portion of the total gravity load of the building at level i.

θ_{im} = The displacement amplitude at the ith level of the building when vibrating in its mth mode.

The modal seismic design coefficient (C_{sm}) shall be determined in accordance with the following formula:

$$C-m = \frac{1.2 A_v S}{R T_m^{2/3}}$$

where:

A_v = Seismic coefficient representing the effective peak velocity-related acceleration as determined in 780 CMR 1612.2.3.

S = The coefficient for the soil-profile characteristics of the site as determined by Table 1612.4.1.

R = The response modification factor determined from Table 1612.4.4.

T_m = The modal period of vibration, in seconds, of the mth mode of the building.

The modal seismic design coefficient (C_{sm}) is not required to exceed 2½ times the seismic coefficient representing the effective peak acceleration (A_a) divided by the response modification factor (R).

Exceptions:

1. The limiting value of the modal seismic design coefficient (C_{sm}) is not applicable to Category D and E buildings with a period of 0.7 seconds or greater located on type S_4 soils.

2 For buildings on soil-profile characteristics S_3 or S_4, the modal seismic design coefficient (C_{sm}) for modes other than the fundamental mode that have periods less than 0.3 seconds is permitted to be determined by the following formula:

$$C_{sm} = \frac{A_a(1.0 + 5.0T_m)}{R}$$

3. For buildings where any modal period of vibration (T_m) exceeds 4.0 seconds, the modal seismic design coefficient (C_{sm}) for that mode is permitted to be determined by the following formula:

$$C_{sm} = \frac{3A_v S}{R T_m^{4/3}}$$

where:

A_a = Seismic coefficient representing the effective peak acceleration as determined in 780 CMR 1612.2.3.

A_v = Seismic coefficient representing the effective peak velocity-related acceleration as determined in 780 CMR 1612.2.3.

R = The response modification factor determined from Table 1612.4.4.

T_m = The modal period of vibration, in seconds, of the mth mode of the building.

S = The coefficient for the soil profile characteristics of the site as determined by Table 1612.4.1.

1612.6.6 Modal forces, deflections and drifts: The modal force (F_{xm}) at each level shall be determined by the following formulas:

$$F_{xm} = C_{vxm} V_m$$

$$C_{vxm} = \frac{w_x \theta_{xm}}{\sum_{i=1}^{n} W_i \theta_{im}}$$

where:

C_{vxm} = The vertical distribution factor in the mth mode.

V_m = The total design lateral force or shear at the base in the mth mode.

w_i and w_x = The portion of the total gravity load of the building (W) located or assigned to level i or x.

θ_{xm} = The displacement amplitude at the xth level of the building when vibrating in the mth mode.

θ_{im} = The displacement amplitude at the ith level of the building when vibrating in the mth mode.

The modal deflection at each level (δ_{xm}) shall be determined by the following formulas:

$$\delta_{xm} = C_d \delta_{xem}$$

$$\delta_{xem} = \left[\frac{g}{4\pi^2}\right]\left[\frac{T_m^2 F_{xm}}{W_x}\right]$$

where:

C_d = The deflection amplification factor determined from Table 1612.4.4.

δ_{xem} = The deflection of level x in the mth mode at the center of the mass at level x determined by an elastic analysis.

g = The acceleration due to gravity (feet per second^2).

T_m = The modal period of vibration, in seconds, of the mth mode of the building.

F_{xm} = The portion of the seismic base shear in the mth mode, induced at level x.

w_x = The portion of the total gravity load of the building (W) located or assigned to level x.

The modal drift in a story (Δ_m) shall be computed as the difference of the deflections (δ_{xm}) at the top and bottom of the story under consideration.

1612.6.7 Modal story shears and moments: The story shears, story overturning moments. and the shear forces and overturning moments in walls and braced frames at each level, due to the seismic forces determined from the appropriate equation in 780 CMR 1612.6.6, shall be computed for each mode by linear static methods.

1612.6.8 Design values: The design value for the modal base shear (V_t), each of the story shear, moment and drift quantities, and the deflection at each level shall be determined by combining their modal values, obtained from 780 CMR 1612.6.6 and 1612.6.7. The combination shall be determined by taking the square root of the sum of the squares of each of the modal values (SRSS method) or by using the Complete Quadratic Combination (CQC) method. When the periods of any two modes used in this analysis differ by less than 25% the CQC method shall be used.

The base shear (V) utilizing the equivalent lateral force procedure in 780 CMR 1612.5 shall be calculated based on a fundamental period of the building (T), in seconds, of 1.2 times the coefficient for the upper limit on the calculated period (C_a) times the approximate fundamental period of the building (T_a). Where the design value for the modal base shear (V_t) is less than the calculated base shear (V) utilizing the equivalent lateral force procedure, the design story shears, moments, drifts and floor deflections shall be multiplied by the following modification factor:

$$\frac{V}{V_t}$$

where:

V = The equivalent lateral force procedure base shear, calculated in accordance with 780 CMR 1612.6 and 780 CMR 1612.5.

V_t = The modal base shear, calculated in accordance with 780 CMR 1612.6

The model base shear (V_t) is not required to exceed the base shear from the equivalent lateral force procedure in 780 CMR 1612.5

1612.6.9 Horizontal shear distribution: The distribution of horizontal shear shall be in accordance with the requirements of 780 CMR 1612.5.3.

1612.6.10 Foundation overturning: The foundation overturning moment at the foundation-soil interface shall not be reduced by more than 10%.

1612.6.11 P-delta effects: The P-delta effects shall be determined in accordance with 780 CMR 1612.5.5.2. The story drifts and story shears shall be determined in accordance with 780 CMR 1612.6.8.

1612.7 Architectural, mechanical and electrical components and systems: All components and systems in buildings shall be designed and constructed to resist seismic forces as determined in accordance with the provisions of 780 CMR 1612.7. Architectural, mechanical and electrical components and systems in buildings assigned to Seismic Hazard Perfrmance Category C, and are in Seismic Hazard Exposure Group I and have a Performance Criteria Factor of 0.5, are exempt from the requirements of 780 CMR 1612.7.

Exceptions:

1. Individual electrical and mechanical components which weigh more than 2,000 pounds

and are located more than 15 feet above the base shall be designed in accordance with 780 CMR 1612.7.4.

2. Elevator components and systems in buildings assigned to Seismic Hazard Performance Category C and are in Seismic Hazard Exposure Group I buildings not more than 70 feet in height are exempt from the requirements of 780 CMR 1612.7.

1612.7.1 Component force application: The component seismic force shall be applied at the center of gravity of the component nonconcurrently in any horizontal direction. Mechanical and electrical components and systems shall be designed for a nonsimultaneous vertical force of 33% of the horizontal force.

1612.7.2 Component force transfer: Components shall be attached such that the component forces are transferred to the structural system of the building. Component seismic attachments shall be positive connections without consideration of frictional resistance.

1612.7.3 Architectural component design: Architectural components and their attachments shall be designed for seismic forces (F_p) determined in accordance with the following formula:

$$F_p = A_v C_c P W_c$$

where:

A_v = The coefficient representing effective peak velocity-related acceleration from 780 CMR 1612.2.3.

C_c = The seismic coefficient for architectural components from Table 1612.7.3.

P = Performance criteria factor from Table 1612.7.3.

W_c = The weight of the architectural component.

1612.7.3.1 Exterior wall panel connections: The connections of exterior wall panels to the building seismic-resisting system shall be designed for the design story drift determined in accordance with 780 CMR 1612.5.5.1 or in accordance with 780 CMR 1612.6.6 and 1612.6.8.

1612.7.3.2 Architectural component deformation: Architectural components shall be designed for the design story drift of the structural seismic-resisting system determined in accordance with 780 CMR 1612.5.5.1 or in accordance with 780 CMR 1612.6.6 and 1612.6.8. Architectural components shall be designed for vertical deflection due to joint rotation of cantilever structural members.

Exception: Architectural components having a performance criteria factor of 0.5 shall be designed for 50% of the design story drift.

1612.7.3.3 Ceilings: Provision shall be made for the lateral support and interaction of other architectural, mechanical and electrical systems or components incorporated into the ceiling which impose seismic forces into the ceiling system.

Table 1612.7.3
ARCHITECTURAL COMPONENT SEISMIC COEFFICIENT (C_c) AND PERFORMANCE CRITERIA FACTOR (P)[a]

Architectural Component	Component Seismic Coefficient (C_c)	Performance Criteria Factor (P) Seismic Hazard Exposure Group		
		I	II	III
1 Exterior nonloadbearing walls[b]	0.9	1.5	1.5	1.5
2 Interior nonloadbearing walls[b],				
Exit, stair and elevator enclosures.	1.5	1.0	1.0	1.5
Other vertical shaft enclosures	0.9	1.0	1.0	1.5
Other nonloadbearing walls	0.9	1.0	1.0	1.5
3 Cantilever elements; parapets, chimneys or stacks	3.0	1.5	1.5	1.5
4 Wall attachments	3.0	1.5	1.5	1.5
5 Veneer connections	3.0	0.7	1.0	1.0
6 Penthouses[c]	0.6	0.7	1.0	1.0
7 Membrane fire protection	0.9	1.0	1.0	1.5
8 Ceilings				
Fireresistance rated membrane	0.9	1.0	1.0	1.5
Nonfireresistance rated membrane	0.6	0.5	1.0	1.0
9 Storage racks, contents included	1.5	1.0	1.0	1.5
10 Access floor, supported equipment included	2.0	0.5	1.0	1.5
11 Elevator and counterweight guardrails and supports	1.25	1.0	1.0	1.5

Note a: See 780 CMR 1612.7 for general exceptions

Note b: See 780 CMR 1612.4.7.2.8 for exterior and interior loadbearing wall requirements

Note c: The design seismic force for a penthouse shall be the larger of the force determined in accordance with 780 CMR 1612.7.3, this table and the force determined in accordance with 780 CMR 1612.5 or 1612.6

1612.7.4 Mechanical, electrical component and system design: Mechanical, electrical components and systems and their attachments shall be designed for seismic forces (F_p) determined in accordance with the following formula:

$$F_p = A_v C_c P a_c W_c$$

where:

A_v = The coefficient representing effective peak velocity-related acceleration from 780 CMR 1612.2.3.

C_c = The seismic coefficient for mechanical, electrical components and systems from Table 1612.7.4(1).

P = Performance criteria factor from 1612.7.4(1).

a_c = The attachment amplification factor determined in accordance with Table 1612.7.4(2).

W_c = The operating weight of the mechanical, electrical component or system.

Alternatively, the seismic forces (F_p) shall be determined by a properly substantiated dynamic analysis subject to approval.

Exception: Bracing of fire sprinkler systems shall be permitted to be in accordance with NFiPA 13 listed in ***Appendix A***.

Table 1612.7.4(1)
MECHANICAL, ELECTRICAL COMPONENT AND SYSTEM SEISMIC COEFFICIENT (C_c) AND PERFORMANCE CRITERIA FACTOR (P)[a]

Mechanical, electrical component or system	Component or system seismic coefficient (C_c)	Performance Criteria Factor (P)		
		Sesimic Hazard Exposure Group		
		I	II	III
1 Fire protection equipment and systems	2.0	1.5	1.5	1.5
2 Emergency or standby electrical systems	2.0	1.5	1.5	1.5
3 Elevator drive, suspension system and controller anchorage	1.25	1.0	1.0	1.5
4 General equipment A. Boilers, furnaces, incinerators, water heaters and other equipment utilizing combustible energy sources or high temperature sources. B. Communication systems C. Electrical bus ducts and primary cable systems[b]. D. Electrical motor control centers, motor control devices, switchgear, transformers and unit substations. E. Reciprocating or rotating equipment F. Tanks, heat exchangers and pressure vessels.	2.0	0.5	1.0	1.5
5 Manufacturing and process machinery	0.67	0.5	1.0	1.5
6 Pipe systems				
Gas and high hazard piping	2.0	1.5	1.5	1.5
Fire suppression piping	2.0	1.5	1.5	1.5
Other pipe systems[c]	0.67	0.5	1.0	1.5
7 HVAC ducts[d]	0.67	0.5	1.0	1.5
8 Electrical panel board	0.67	0.5	1.0	1.5
9 Lighting fixtures[e]	0.67	0.5	1.0	1.5

Note a: Sec 780 CMR 1612.7 for general exceptions

Note b: Electrical conduit seismic restraints are not required for any one of the following conditions

1. Conduit suspended by individual hangars 12 inches or less in length from the top of the conduit to the supporting structure
2. Conduit which has less than $2^{1/2}$ inches inside diameter

Note c: Seismic restraints are not required for any one of the following conditions for other pipe systems

1. Piping suspended by individual hangars 12 inches or less in length from the top of the pipe to the supporting structure
2. Piping in boiler and mechanical rroms which has less than 1¼ inches inside diameter.
3. Piping in other areas which has less than 2½ inches inside diameter.

Note d: Seismic restraints are not required for any one of the following conditions for HVAC ducts:

1. Ducts suspended by individual hangars 12 inches or less in length from the top of the duct to the supporting structure
2. Ducts which have a cross-sectional area less than 6 square feet.

Note e: Pendulum lighting fixtures sahll be designed based on a component seismic coefficient (C_c) of 1.5. The vertical supportshall be designed with a factor of safety of 4.0

Table 1612.7.4(2)
ATTACHMENT AMPLIFICATION FACTOR (a_c)

Component mounting system	Attachment amplification factor (a_a)
Fixed of direct connection	1.0
Resilient-mounting system	
Seismic-activated restraining device	1.0
Elastic restraining device where:	
$\frac{T_c}{T}<0.6$ or $\frac{T_c}{T}>1.4^a$	1.0
$\frac{T_c}{T}\geq 0.6$ or $\frac{T_c}{T}\leq 1.4^a$	2.0

Note a: T is the fundemental period of the building, in seconds, determined by 780 CMR 1612.5.1.2 or 780 CMR 1612.6.4. T_c is the fundemental period, in seconds, of the component and its attachement determined by 780 CMR 1612.7.4.1

1612.7.4.1 Component period: The fundamental period of the component and its attachments (T_c), in seconds, shall be determined by the following formula:

$$T_c = 0.32\sqrt{\frac{W_c}{K}}$$

where:

W_c = Weight of the component (Ibs.).

For stable resilient-mounting attachments:

K = Spring stiffness constant (Ib./in.).

For other resilient-mounting attachments:

K = Slope of the load vs deflection curve (Ib./in.) at the point of loading.

Alternatively, the fundamental period of the component (T_c), in seconds, shall be determined by experimental test data or by a properly substantiated analysis.

1612.7.4.2 Component attachment: Systems, components and the means of their attachment shall be designed to accommodate relative seismic displacements between points of support. Displacements at points of support shall be determined in accordance with 780 CMR 1612.5.5 or 1612.6.8. Relative lateral displacements at points of support shall be determined considering the difference in elevation between the supports and considering full out-of-phase displacements across portions of the building that are capable of moving in a differential manner such as at seismic and expansion joints. Anchor bolts shall be designed for combined shear and tension. Restraining devices shall be provided to limit the horizontal and vertical motions, to prevent component resonance and to prevent overturning.

1612.7.5 Elevator design requirements: The design and construction of elevators and elevator components in buildings assigned to Seismic Performance Category D or E, in accordance with 780 CMR 1612.2, shall comply with the requirements in Appendix F of ASME A17.1 listed in *Appendix A*.

780 CMR 1613.0 CONCENTRATED LOADS

1613.1 General: Floors and roofs of buildings in the locations specified in Table 1613.1 shall be designed to support the uniformly distributed *live loads* prescribed in 780 CMR 1606.0 or the minimum concentrated *loads* in pounds prescribed in Table 1613.1, whichever produces the greater stresses. If the anticipated actual *loads* are higher, the actual *loads* shall be utilized. Unless otherwise specified, the indicated concentration shall be assumed to occupy an area of 2½ square feet and shall be so located as to produce the maximum stress conditions in the structural members.

Table 1613.1
MINIMUM CONCENTRATED LOADS

Location	Load (pounds)[a]
Elevator machine room grating (on area of 4 square inches)	300
Finish light plate floor construction (on area of 4 square inches)	200
Garages	See 780 CMR 1613.2
Greenhouse roof bars, purlins and rafters	100
Hospitals and ward rooms	1,000
Libraries	1,000
Manufacturing and storage buildings	2,000
Mechanical equipment	See 780 CMR 1613.3
Mercantile areas	2,000
Office	2,000
Schools	1,000
Scuttles, skylight ribs and accessible ceiling ribs and hangers (over an area of one suare inch)	200
Sidewalks or vehicular driveways subject to trucking	8,000
Stair treads (over area of 4 square inches at center of tread)	300

Note a: 1 pound = 4.448 N; 1 square inch=645.16 mm^2

1613.2 Garages: Minimum concentrated *loads* for garages or portions of buildings occupied for parking motor vehicles shall be:

1. For passenger cars accommodating not more than nine passengers, 2,000 pounds (8896 N) acting on an area of 20 square inches (12900 mm^2);
2. Mechanical parking structures without slab, passenger cars only, 1500 pounds (6672 N) per wheel; and
3. For trucks or buses, on slabs, applicable wheel loads and tire contact areas specified in AASHTO Standard Specification for Highway Bridges with interim revisions to 1995 (see *Appendix A*).

1613.3 Mechanical Equipment: The actual concentrated *loads* of the machinery, shall be used for buildings containing mechanical material handling equipment, machines or other heavy apparatus.

780 CMR 1614.0 IMPACT LOADS

1614.1 General: The *live loads* specified in 780 CMR 1606.0 shall be assumed to include adequate allowance for ordinary impact conditions. Provisions shall be made in the structural design for special occupancies and *loads* which involve vibration and impact forces. Where dynamic effects such as resonance and fatigue are likely to be important as a result of cyclical loading, a dynamic analysis shall be carried out.

1614.2 Elevators: Structural supports for elevators, dumbwaiters, escalators and moving walks shall be designed for the *loads* and within the limits of the deflection specified in the Massachusetts State Department of Public Safety, Board Elevator Regulations (524 CMR 1.0 through 34.0), listed in ***Appendix A***. (In accordance with the Regulations, all suspended elevator *loads* shall be increased 100% for impact.

1614.3 Machinery: For the purposes of design, the weight of machinery and moving *loads* shall be increased as follows to allow for impact:

Elevator machinery	100%
Light machinery, shaft- or motor-driven	20%
Reciprocating machinery or power-driven units	50%

These percentages shall be increased where so specified by the manufacturer.

1614.4 Hangers for floors and stairs: *Live loads* on hangers supporting floors or stairs shall be multiplied by an impact factor of 1.33.

780 CMR 1615.0 SPECIAL LOADS

1615.1 General: Provisions shall be made for all special *loads* herein prescribed and all other special *loads* to which the building or structure is subjected.

1615.2 Hydrostatic uplift: All foundation slabs and other footings subjected to water pressure shall be designed to resist an uplift equal to the full hydrostatic pressure. All foundation slabs, footings and walls of buildings located in flood-hazard zones (A Zones) and high-hazard zones (V Zones) shall be designed to resist uplift and lateral *loads* associated with hydrostatic pressure resulting from flooding to the base flood elevation. Counteracting weight shall be reduced to 0.85 times the actual weight.

1615.3 Hydrodynamic loads: For buildings located in flood-hazard zones (A Zones) or high-hazard zones (V Zones), all structural components located below the base flood elevation shall be designed to resist hydrodynamic forces resulting from velocity waters during flooding to the base flood elevation.

1615.4 Partitions and Interior Finish: Partitions, their components and other interior finish shall have adequate strength to resist a horizontal load of not less than 5 psf.

1615.5 Guardrails and handrails: All required guardrails and handrails shall be designed and constructed to the structural loading conditions set forth in Table 1615.5. without exceeding the allowable design working stresses of the materials, anchorage and connecting devices utilized. The allowable working stresses shall be as defined by the appropriate design standard. Each load shall be applied so as to produce the maximum stress in each of the respective components.

Each load shall be applied in the direction indicated in the table. The concentrated load and uniformly distributed *loads* need not be applied simultaneously. The *loads* applied to in-fill areas need not be applied simultaneously with the *loads* applied on the top railing.

TABLE 1615.5
LOADS ON GUARDRAILS AND HANDRAILS

Type of Occupancy	Location of Load	Type of load	Direction of Load	Magnitude of Load
All	Handrails	Concentrated	Any	200 lb.
All, except dwelling units in Use Groups R-2 and R-3	Handrails	Uniformly distributed	Any	50 lb/ft.
All, except as noted otherwise	Guardrails, top railing members	Concentrated	Any	200 lb.
All, except dwelling units in Use Groups R-2 and R-3 and as noted otherwise	Guardrails, top railing members	Uniformly distributed	Vertical simultaneously with horizontal	100 lb/ft 50 lb/ft.
All	Guardrails, in-fill areas	Concentrated	Any	200 lb. applied over 1 sf. area
Grandstands, stadia, arenas, and similar structures used for public assembly	Guardrails, top railing members	Concentrated	Any	300 lb.
Grandstands, stadia, arenas, and similar structures used for public assembly	Guardrails, top railing members	Uniformly distributed	Any	100 lb/ft

1615.6 Grandstands, stadia and similar structures shall be designed to resist, in combination with design *wind loads*, a horizontal swaying load applied parallel to the row of seats of not less than 24 pounds per lineal foot of seats per row, or in combination with wind, a horizontal swaying load applied transversely of not less than ten pounds per lineal foot of seats per row. Foot boards and seat boards shall be designed for a minimum vertical load of 120 lb. per lineal foot.

1615.7 Horizontal crane loads: A lateral force shall be applied perpendicular (normal) to the span of runway beams and a lateral force shall be applied parallel (longitudinal) to the beam span.

(a) The lateral force acting normal to the runway shall be applied at the top of the rail, and shall be 20% for power-operated crane trolleys, and 10% for hand-operated trolleys, of the sum of the weights of the maximum lifted load and of the crane trolley. This force shall be distributed to tributary supporting structural members based on the relative lateral stiffness of each component structure supporting the rails.

(b) The longitudinal force acting parallel to the runway and applied at the top of the rail shall be 10% of the maximum wheel *loads* of the crane.

(c) Reductions in these *loads* may be permitted if substantiating technical data acceptable to the building official is provided.

(d) These *loads* need not be considered in combination with *wind loads*.

1615.8 Temperature loads: Movements, and forces resulting from restraint of movements, produced by changes in temperature shall be considered in the design of buildings and structures.

780 CMR 1616.0 COMBINATION OF LOADS

1616.1 General: Combinations of structural *loads* shall be considered in accordance with 780 CMR 1616.0. *Live loads* may be reduced as appropriate in accordance with 780 CMR 1616.0. In addition to the load combinations listed, the following shall be considered in design: structural effects of *loads* due to fluids, *loads* due to the weight and lateral pressure of soil and water in soil, rain *loads* including ponding, and effects arising from contraction or expansion resulting from temperature changes, shrinkage, moisture changes, creep in component materials, and movement due to differential settlement.

1616.1.1 Design Methods: As permitted by the structural design standards listed in ***Appendix A***, the structural designer may use either the allowable stress design method (also called working stress design) or the strength design method (also called limit states design, load and resistance factor design, or ultimate strength design). The applicable load combinations given in 780 CMR 1616.1 shall govern over the load combinations given in the design standards in ***Appendix A***.

Exception: Use load combinations from design standards in ***Appendix A*** which do not include wind or seismic *loads*, if those combinations produce a more unfavorable effect in the structure or foundation.

1616.2 Load Combinations Using Allowable Stress Design

1616.2.1 Basic Combinations. All *loads* listed herein shall be considered to act in the following combinations, whichever produces the most unfavorable effect in the building, foundation or structural member being considered. The most unfavorable effect may occur when one or more of the contributing *loads* is not acting.

1. Dead
2. Dead + floor live + roof live (or snow)
3. Dead + floor live + 0.5 roof live (or 0.5 snow) + wind
4. Dead + floor live + roof live (or snow) + 0.5 wind
5. 0.67 Dead - wind
6. 0.67 Dead - 0.8 seismic
7. Dead + 0.9 floor live + 0.6 snow + 0.8 seismic

1616.3 Load Combinations Using Strength Design

1616.3.1 Basic Combinations. All *loads* listed herein shall be considered to act in the following factored load combinations, whichever produces the most unfavorable effect in the building, foundation or structural member being considered. The most unfavorable effect may occur when one or more of the contributing *loads* is not acting.

1. 1.4 Dead
2. 1.3 Dead + 1.6 floor live + 0.5 roof live (or 0.5 snow)
3. 1.3 Dead + 0.5 floor live + 1.6 roof live (or 1.6 snow)
4. 1.3 Dead + 0.5 floor live + 0.5 roof live (or 0.5 snow) + 1.3 wind
5. 1.3 Dead + 1.6 roof live (or 1.6 snow) + 0.8 wind
6. 0.9 Dead - 1.3 wind
7. 1.3 Dead + 1.0 floor live + 0.7 snow + 1.0 seismic
8. (0.90 - 0.5 A_V) Dead - 1.0 seismic

Exception: The load factor on floor *live load* in combinations 3 and 4 shall equal 1.0 for garages, areas occupied as places of public assembly, and all areas where the floor live load is greater than 100 pounds per square foot.

1616.4 Amplification of seismic load effects for special conditions: Seismic load effects shall be amplified by the factor 2R/5, where 2R/5 shall be not less than 1.0, in allowable stress design 780 CMR 1616.2.1, and in strength design 780 CMR 1616.3.1 for the following conditions. Note: In allowable stress design load combinations 6 and 7, the term "0.8 seismic" shall be replaced by "0.8(2R/5) seismic".

1. For computing the design forces in members such as columns, girders or trusses which support discontinuous lateral force-resisting elements when using Load Combination 7 in 780 CMR 1616.2.1 (Allowable Stress Design) or Load Combination 7 in 780 CMR 1616.3.1 (Strength Design). However, the computed forces in such members need not exceed the capacity of other elements of the structure to transfer such forces into these members. The capacity of the other elements to transfer such forces shall not be less than 1.25 times the computed design strengths of the other elements.
2. For computing the design forces in members and connections that do not develop the full strength of the weaker member connected when using Load Combination 6 in 780 CMR 1616.2.1 (Allowable Stress Design) or Load Combination 8 in 780 CMR 1616.3.1 (Strength Design). However, the design forces need not exceed the limit determined by the capacity of the foundation to resist overturning uplift.

1616.5 Counteracting Load: Where the effects of design *loads* counteract one another in a structural member or joint, the design shall account for and shall ensure adequate safety for possible stress reversals.

1616.6 Stress Increases: All allowable stresses and soil load-bearing values specified in 780 CMR for allowable stress design are permitted to be increased one-third where *wind load* or seismic load combinations are utilized.

1616.7 Crane hook *loads* are not required to be combined with the roof *live load*, nor with seismic load, nor with more than 0.75 of the snow load or one-half of the *wind load*

780 CMR 1617.0 EXISTING BUILDINGS

1617.1 General: The repair, reconstruction, alteration, addition to or change in use or occupancy of existing buildings shall comply with 780 CMR 34.

1617.2 Posted live load: When floor *live loads* required by the Code have been increased from those heretofore approved for a building or structure in a particular use group and there is no change to a new use requiring greater floor *loads* than those currently required for the original use group, the floors so affected may be posted for the originally approved *live loads*, provided the building is structurally safe in all its parts, is adequate for its existing use, and the public safety is not endangered thereby.

NON-TEXT PAGE

CHAPTER 17

STRUCTURAL TESTS AND INSPECTIONS

(A substantial portion of this Chapter is unique to Massachusetts)

780 CMR 1701.0 GENERAL

1701.1 Scope: The provisions of 780 CMR 17 shall govern the quality, workmanship and requirements for all materials hereafter used in the construction of buildings and structures. All materials of construction and tests shall conform to the applicable standards listed in 780 CMR.

1701.2 New materials: All new building materials, equipment, appliances, systems or methods of construction not provided for in 780 CMR, and any material of questioned suitability proposed for use in the construction of a building or structure, shall be subjected to the tests prescribed in 780 CMR 17 and in the *approved rules* to determine character, quality and limitations of use.

In accordance with 780 CMR 109.3.4, the building official may require that such materials be presented before the Construction Materials Safety Board for approval.

1701.3 Used materials: The use of all second-hand materials which meet the minimum requirements of this code for new materials shall be permitted.

780 CMR 1702.0 DEFINITIONS

1702.1 General: The following words and terms shall, for the purposes of 780 CMR 1702.0 and as used elsewhere in 780 CMR, have the meanings shown herein.

Approved agency: An established and recognized agency regularly engaged in conducting tests or furnishing inspection services, when such agency has been approved (see 780 CMR 1704.0).

Fabricated item: Structural, loadbearing or lateral *load*-resisting assemblies consisting of materials assembled prior to installation in a building or structure, or subjected to operations such as heat treatment, thermal cutting, cold working or reforming after manufacture and prior to installation in a building or structure. Materials produced in accordance with standard specifications referenced by 780 CMR, such as rolled structural steel shapes, steel-reinforcing bars, masonry units and plywood sheets, shall not be considered "fabricated items."

Inspection, *structural*: inspection as herein required of the installation, fabrication, erection or placement of components and connections requiring special expertise to ensure adequacy (see 780 CMR 116.0 and 1705.0).

Label: A plate, tag or other device which is permanently and prominently affixed to a product or material indicating that it has been tested and evaluated by an *approved agency* (see 780 CMR 1704.3).

Structural Engineer of Record (SER): The ***registered professional engineer*** whose professional seal of registration and signature appears on the design documents submitted with the building permit application, or the alternate ***(SER)*** who succeeds the ***(SER)***, as provided in 780 CMR 1705.3.3.

780 CMR 1703.0 INFORMATION REQUIRED

1703.1 Material performance: Where the quality of materials is essential for conformance to 780 CMR, specific information shall be given to establish such quality; and 780 CMR shall not be cited, or the term "legal" or the term's equivalent be used as a substitute for specific information. This information shall consist of test reports conducted by an *approved testing agency* in accordance with the standards referenced in ***Appendix A*** or such other information as necessary for the code official to determine that the material meets the applicable code requirements.

1703.1.1 Labeling: Where materials or assemblies are required by 780 CMR to be *labeled*, such materials and assemblies shall be labeled by an *approved agency* in accordance with 780 CMR 1704.0.

1703.2 Research and investigation: Sufficient technical data shall be submitted to substantiate the proposed use of any material or assembly. If it is determined that the evidence submitted is satisfactory proof of performance for the use intended, the code official shall approve the use of the material or assembly subject to the requirements of 780 CMR. The cost of all tests, reports and investigations required under 780 CMR 17 shall be paid by the permit applicant.

1703.2.1 Research reports: Supporting data, where necessary to assist in the approval of all materials or assemblies not specifically provided for in 780 CMR, shall consist of valid research reports from approved sources.

1703.3 Evaluation and follow-up inspection services: Prior to the approval of a closed prefabricated assembly, the permit applicant shall submit an evaluation report of each prefabricated assembly. The report shall indicate the complete details of the assembly, including a description of the assembly and the assembly's components, the basis upon which the assembly is being evaluated, test results and similar information, and other data as necessary for the code official to determine conformance to 780 CMR.

1703.3.1 Evaluation service: The code official shall review evaluation reports from approved sources for adequacy and conformance to 780 CMR.

1703.3.2 Follow-up inspection: The owner shall provide for *structural inspections* of *fabricated items* in accordance with 780 CMR 1705.

1703.3.3 Test and inspection records: Copies of all necessary test and inspection records shall be filed with the code official.

780 CMR 1704.0 APPROVALS

1704.1 Written approvals: Where approvals by the *building official* are required by the provisions of 780 CMR, such approvals shall be given in *writing* within a reasonable time after satisfactory completion of all the required tests and submissions of required test reports.

1704.2 Approved record: For any material, appliance, equipment, system or method of construction that has been approved, a record of such approval, including all of the conditions and limitations of the approval, shall be kept on file in the *building official's* office and shall be open to public inspection at all appropriate times.

1704.3 Labeling: Products and materials required to be *labeled* shall be *labeled* in accordance with the procedures set forth in 780 CMR 1704.3.1 through 1704.3.3.

1704.3.1 Testing: An *approved agency* shall test a representative sample of the product or material being *labeled* to the relevant standard or standards. The *approved agency* shall maintain a record of all of the tests performed. The record shall provide sufficient detail to verify compliance with the test standard.

1704.3.2 Inspection and identification: The *approved agency* shall periodically perform an inspection, which shall be in-plant if necessary, of the product or material that is to be *labeled*. The inspection shall verify that the *labeled* product or material is representative of the product or material tested.

1704.3.2.1 Independent: The *agency* to be approved shall be objective and competent. The *agency* shall also disclose all possible conflicts of interest so that objectivity can be confirmed.

1704.3.2.2 Equipment: An *approved agency* shall have adequate equipment to perform all required tests. The equipment shall be periodically calibrated.

1704.3.2.3 Personnel: An *approved agency* shall employ experienced personnel educated in conducting, supervising and evaluating tests.

1704.3.3 Label information: The label shall contain the manufacturer's or distributor's identification, model number, serial number, or definitive information describing the product or material's performance characteristics and *approved agency*'s identification.

1704.4 Heretofore-approved materials: The use of any material already *fabricated* or of any construction already erected, which conformed to requirements or approvals heretofore in effect, shall be permitted to continue, if not detrimental to life. health or safety of the public.

780 CMR 1705.0 *REQUIREMENTS FOR STRUCTURAL TESTS AND INSPECTIONS*

1705.1 General: The permit applicant shall provide *special inspections* where application is made for construction as described in 780 CMR 1705.0.

Exceptions:
1. Structural tests and inspections are not required for building components unless the design involves the practice of professional engineering or architecture as defined by M.G.L. c 112 § 60K and/or M.G.L. c 112 § 81D.
2. *Structural tests and inspections* are not required for occupancies in Use Group R-3.

1705.2 ***Purpose: The purpose of the structural tests and inspections specified in 780 CMR 1705 is to provide assurance to the owner and the building official that the construction complies with the requirements of the structural design by the SER. These tests and inspections are for quality asurance audits and their implementation does not relieve the contractor or sub-contractors of their responsibility for quality control of the work and any design for which they are responsible.***

1705.3 ***Program for tests and inspections: The SER shall establish a program of structural tests and inspections which meets the requiremnts of 780 CMR 17. The SER shall direct the implementation of this program and select any structural inspectors required to undertake the program. All fees and costs related to the implementation of this program shall be borne by the owner.***

1705.3.1 Building permit requirement: *The permit applicant shall submit the program of structural tests and inspections prepared by the SER as a condition for permit issuance. This program shall include a complete list of materials and work requiring structural tests and inspections by 780 CMR 1705.1, the inspections to be performed and a list of the individuals, approved agencies and firms intended to be retained for conducting such inspections.*

1705.3.2 Report requirement: *A final report stating that the program of structural tests and inspections has been satisfactorily completed shall be submitted to the owner and the building official by the SER prior to the issuance of the certificate of occupancy. As construction progresses, inspection reports and records of tests and measurements shall be maintained by the SER. When these records are requested by the building official, they shall be submitted promptly, in accordance with procedures established by the building official prior to the start of construction. When deviations from design requirements are determined during tests or inspections, the SER shall promptly report such to the contractor for correction. If the contractor fails to correct any reported deviation, it shall be reported to the building official by the SER.*

1705.3.3 Alternate SER*: If the SER cannot continue with the project, the owner shall retain an alternate qualified registered professional engineer to review the design and assume the full responsibilities of the former SER.*

1705.3.4 Performance specifiactions*: The SER shall identify, in the program of structural tests and inspections submitted with the building permit application, any structural elements or systems that the SER has specified to be designed by another registered professional engineer. The SER shall review the design of these structural elements or systems and shall include them in the program of structural tests and inspections.*

1705.3.5 *Waiver of structural inspection by the SER: Where, in then opinion of the SER, any portion of the contractor's quality control program meets the inspection and test requirements of 780 CMR 1705, the SER may reduce the specifed quality assurance structural inspection and test program following approval by the building official. When this is done the final inspection report shall also include reference to the results of those inspections performed by the contractor. As construction progresses, reports of inspections and measurements shall be submitted to the SER and, if requested, to the building official.*

1705.4 Inspection of fabricators: Where fabrication of structural loadbearing members and assemblies is being performed on the premises of a fabricator's shop, *structural inspection* of the *fabricated items* shall be required. The *fabricated items* shall be *inspected* as required by 780 CMR 1705.0 and as required elsewhere in 780 CMR.

1705.4.1 Fabrication procedures: The special inspector shall verify that the fabricator maintains detailed fabrication and quality control procedures which provide a basis for inspection control of the workmanship and the fabricator's ability to conform to approved drawings, project specifications and referenced standards. The special inspector shall review the procedures for completeness and adequacy relative to the code requirements for the fabricator's scope of work.

1705.4.2 Procedures implementation: The structural inspector shall verify that the fabricator is properly implementing the fabrication and quality control procedures outlined in 780 CMR 1705.4.1.

Exception: *Structural inspections as required by 780 CMR 1705.4 may be reduced by the SER where the fabricator maintains an agreement with an approved independent inspection or quality control agency to conduct periodic in-plant inspections at the fabricator's plant, at a frequency that will assure the fabricator's conformance to the requirements of the inspection agency's approved quality control program.*

1705.5 Steel construction: The *structural inspections* for steel elements of buildings and structures shall be as required by 780 CMR 1705.5.1 through 1705.5.3.

1705.5.1 Inspection of steel fabricators: The permit applicant shall provide *structral inspection* of steel *fabricated items* in accordance with the provisions of 780 CMR 1705.2.

Exception: *Structural inspection* of the steel fabrication process shall not be required where the fabricator does not perform any welding, thermal cutting or heating operation of any kind as part of the fabrication process. In such cases, the fabricator shall be required to submit a detailed procedure for material control which demonstrates the fabricator's ability to maintain suitable records and procedures such that, at any time during the fabrication process, the material specification, grade and mill test reports for the main stress-carrying elements and bolts are capable of being determined.

1705.5.2 Material receiving: All main stress-carrying elements, welding material and bolting material shall be *inspected* for conformance to Table 1705.5.2.

Table 1705.5.2
INSPECTION FOR STEEL MATERIALS

Material	Inspection requuired	Reference[a] for criteria
Bolts, nuts, washers	1. Material identification markings 2. Conformance to ASTM standards specified by the design engineer Manufacturer's certificate of compliance is required	Applicable ASTM material specifications; AISC ASD, Section A3.4; AISC LRFD, Section A3.3
Structural steel	1. Material identification markings 2. Conformance to ASTM standards specified in the approved plans and specifications	ASTM A6 or ASTM A568 Provide certified test reports in accordance with ASTM A6 or ASTM A568
Weld filter materials	1. Conformance to AWS specifications as specified in the approved plans and specifications. Manufacturer's certificate of compliance is required	AISC ASD, Section A3.6; AISC LRFD, Section A3.5

Note a. The specific standards referenced are those listed in *Appendix A*.

1705.5.3 Erection: *Structural inspections* are required for bolts, welding and details as specified in 780 CMR 1705.5.3.1 through 1705.5.3.3.

1705.5.3.1 Installation of high-strength bolts: Inspection shall be as specified in Section 9 of the RCSC Specification for Structural Joints Using A325 or A490 Bolts listed in ***Appendix A***.

1705.5.3.2 Welding: Weld inspection shall be in compliance with Section 6 of AWS D1.1 listed in ***Appendix A***. Weld inspectors shall be certified in accordance with AWS D1.1 listed in ***Appendix A***.

1705.5.3.2.1 Welding of the structural seismic-resisting system: Welding of the structural seismic-resisting system of buildings, shall be *inspected* in accordance with 780 CMR 1705.5.3.2.2 and 1705.5.3.2.3. Each complete penetration groove weld in joints and splices shall be tested for the full length of the weld either by ultrasonic testing or by other approved methods, for special moment frames and eccentrically braced frames.

Exception: The nondestructive testing rate for welds made by an individual welder is permitted to be reduced to 25% of the welds, with the approval of the **SER**, provided the weld inspection reject rate is 5% or less.

1705.5.3.2.2 Column splice welds: Column splice welds, which are partial penetration groove welds, shall be tested by ultrasonic testing or other approved methods at a percentage rate established by ***SER***. All partial penetration column splice welds designed for axial or flexural tension from seismic forces shall be tested.

1705.5.3.2.3 Base metal testing: Base metal having a thickness more than 1.5 inches (38 mm) and subject to through-thickness weld shrinkage strains shall be ultrasonically tested for discontinuities behind and adjacent to the welds after joint welding. Any material discontinuities shall be evaluated based on the criteria established in the *construction documents* by the ***SER***.

1705.5.3.3 Details: The structural inspector shall perform an inspection of the steel frame to verify compliance with the details shown on the approved *construction documents*, such as bracing, stiffening, member locations and proper application of joint details at each connection.

1705.6 Concrete construction: The *structural inspections* for concrete structures and concreting operations shall be as required by 780 CMR 1705.6.1 through 1705.6.6.

Exception: *Structural inspections* shall not be required for:

1. Concrete footings of buildings three stories or less in height which are fully supported on earth or rock.
2. Nonstructural concrete slabs supported directly on the ground, including prestressed slabs on grade, where the effective prestress in the concrete is less than 150 psi (0.11 kg/mm^2).
3. Plain concrete foundation walls constructed in accordance with Table 1812.3.2.
4. Concrete patios, driveways and sidewalks, on grade.

1705.6.1 Materials: In the absence of sufficient data or documentation providing evidence of conformance to quality standards for materials in Chapter 3 of ACI 318 listed in ***Appendix A*** the code official shall require testing of materials in accordance with the appropriate standards and criteria for the material in Chapter 3 of ACI 318 listed in ***Appendix A***. Weldability of reinforcement that conforms to ASTM A706 listed in ***Appendix A*** shall be determined in accordance with the requirements of 780 CMR 1906.5.2.

1705.6.2 Installation of reinforcing and prestressing steel: The location and installation details of reinforcing and prestressing steel shall be *inspected* for compliance with the approved *construction documents* and ACI 318 (such as Sections 7.4, 7.5, 7.6 and 7.7) listed in ***Appendix A***. Welding of reinforcing of the structural seismic-resisting system shall be *inspected*.

1705.6.3 Concreting operations: During placing and curing of concrete, the *special inspections* listed in Table 1705.6.3 shall be performed.

Table 1705.6.3
REQUIRED INSPECTIONS DURING CONCRETING OPERATIONS

Required inspection	Reference[a] for criteria
1. Evaluation of concrete strength, except as exempted by 780 CMR1908.3.1(3).	ACI 318 Section 5.6
2. Inspection for use of proper mix proportions and proper mix techniques.	ACI 318 Chapter 4, Sections 5.2, 5.3, 5.4 and 5.8
3. Inspection during concrete placement, for proper application techniques.	ACI 318 Sections 5.9 and 5.10
4. Inspection for maintenance of specified curing temperatures and techniques.	ACI 318 Sections 5.11, 5.12 and 5.13

Note a. ACI 318 listed in ***Appendix A***

1705.6.4 Inspection during prestressing: Inspection during the application of prestressing forces shall be performed to determine compliance with Section 18.18 of ACI 318 listed in ***Appendix A***.

1705.6.4.1 Inspection during grouting: Inspection during the grouting of bonded prestressing tendons in the structural seismic-resisting system shall be performed.

1705.6.5 Manufacture of precast concrete: The manufacture of precast concrete, as required by 780 CMR 1705.4, shall be subject to a quality control program administered by an *approved agency*.

1705.6.6 Erection of precast concrete: Erection of precast concrete shall be *inspected* for compliance with the approved plans and erection drawings.

1705.7 Masonry construction: The *structural inspections* listed in Table 1705.7 shall be required for masonry construction.

Table 1705.7
SPECIAL INSPECTIONS FOR MASONRY CONSTRUCTION

Inspection or test	Referenced[a] criteria	
	ACI 530/ ASCE5/ TMS 402	ACI 530.1 ASCE 6/ TMS 602
1. Material		Sec.2.2
2. Masonry strength		Sec. 1.6
3. Construction operations:		
a. Proportioning, mixing consistency of mortar and grout		Sec. 2.3.2.5 Sec 4.2.2
b. Application of mortar grout and masonry units		Sec. 2.3.3.3 Sec. 4.3.3
c. Condition, size, location and spacing of reinforcement	Chapter 8	
d. Protection of masonry during cold weather (temperature below 40°F) or hot weather (temperature above 100°F)		Sec. 2.3.2.2 Sec. 2.3.2.3
e. Anchorage	Sec. 4.2 Sec. 5.14	
4. Inspection of welding of reinforcement, grouting, consolidation and reconsolidation for buildings assigned to Seismic Performance Category Cor D in accordance with 780 CMR 1612.2.7	Note b.	Note b.

Note a. The specific standards referenced are those listed in ***Appendix A***.

Note b. Referenced criteria not applicable.

1705.8 Wood construction: *Structural inspections* of the fabrication process of wood structural elements and assemblies shall be in accordance with 780 CMR 1705.4. *Structural inspection* is required for nailing, bolting, structural gluing or other fastening of the structural seismic-resisting system.

1705.9 Prepared fill: The *structural inspections* for prepared fill shall be as required by 780 CMR 1705.9.1 through 1705.9.3. The approved report, required by 780 CMR 1804.1, shall be used to determine compliance.

1705.9.1 Site preparation: Prior to placement of the prepared fill, the structural inspector shall determine that the site has been prepared in accordance with the approved report.

1705.9.2 During fill placement: During the placement and compaction of the fill material, the structural inspector shall determine that the material being used and the maximum lift thicknesses comply with the approved report.

1705.9.3 Evaluation of in-place density: The structural inspector shall determine, at the approved frequency, that the in-place dry density of the compacted fill complies with the approved report.

1705.10 Pile foundations: *Structural inspections* of pile foundations are required as provided for in 780 CMR 1816.13.

1705.11 Pier foundations: *Structural inspection* is required for pier foundations.

1705.12 Wall panels and veneers: *Structural inspection* is required for exterior wall panels and their attachment to the building structure.

1705.13 ***Light gauge metal framing: Structural inspection is required for light gauge metal framing systems for roofs, floors, and load bearing walls and for light gauge metal framing in exterior curtain walls that have a story height greater than ten feet.***

1705.14 Special cases: *Structural inspections* shall be required for proposed work which is, in the opinion of the code official, unusual in its nature, such as:

1. Construction of materials and systems which are alternatives to materials and systems prescribed by 780 CMR.
2. Unusual design applications of materials described in 780 CMR.
3. Materials and systems required to be installed in accordance with additional manufacturer's instructions that prescribe requirements not contained in 780 CMR or in standards referenced by 780 CMR.

780 CMR 1706.0 DESIGN STRENGTHS OF MATERIALS

1706.1 Conformance to standards: The design strengths and permissible stresses of any structural material that is identified as to manufacture and grade by mill tests, or the strength and stress grade is otherwise confirmed to the satisfaction of the code official, shall conform to the specifications and methods of design of accepted engineering practice or the approved rules in the absence of applicable standards.

1706.2 New materials: For materials which are not specifically provided for in 780 CMR, the design strengths and permissible stresses shall be established by tests as provided for in 780 CMR 1708.0 and 1709.9.

780 CMR 1707.0 ALTERNATIVE TEST PROCEDURE

1707.1 General: In the absence of approved rules or other approved standards, the code official shall make, or cause to be made, the necessary tests and investigations; or the code official shall accept duly authenticated reports from approved agencies in respect to the quality and manner of use of new materials or assemblies as provided for in 780 CMR 106.0. The cost of all tests and other investigations required under the provisions of 780 CMR shall be borne by the permit applicant.

780 CMR 1708.0 TEST SAFE LOAD

1708.1 Where required: Where proposed construction is not capable of being designed by approved engineering analysis, or where proposed construction design method does not comply with the applicable material design standard listed in ***Appendix A***, the system of construction or the structural unit and the connections shall be subjected to the tests prescribed in 780 CMR 1710.0. The code official shall accept certified reports of such tests conducted by an *approved testing agency*, provided that such tests meet the requirements of 780 CMR and approved procedures.

780 CMR 1709.0 IN-SITU LOAD TESTS

1709.1 General: Whenever there is a reasonable doubt as to the stability or loadbearing capacity of a completed building, structure or portion thereof for the expected *loads*, an engineering assessment shall be required. The engineering assessment shall involve either a structural analysis or an in-situ load test, or both. The structural analysis shall be based upon actual material properties and other as-built conditions which affect stability or loadbearing capacity, and shall be conducted in accordance with the applicable design standard listed in ***Appendix A***. If the structural assessment determines that the loadbearing capacity is less than that required by the code, load tests shall be conducted in accordance with 780 CMR 1709.2. If the building, structure or portion thereof is found to have inadequate stability or loadbearing capacity for the expected *loads*, modifications to insure structural adequacy or the removal of the inadequate construction shall be required.

1709.2 Test standards: All structural components and assemblies shall be tested in accordance with the appropriate material standards listed in ***Appendix A***. In the absence of a standard listed in ***Appendix A*** that contains an applicable load test procedure, the test procedure shall be developed by a *registered professional engineer* and approved. The test procedure shall simulate the *loads* and conditions of application that the completed structure or portion thereof will be subjected to in normal use.

1709.3 In-situ load tests: All in-situ load tests shall be conducted in accordance with 780 CMR 1709.3.1 or 1709.3.2 and shall be supervised by a *registered professional engineer*. The test shall simulate the applicable loading conditions specified in 780 CMR 16 as necessary to address the concerns regarding structural stability of the building, structure or portion thereof.

1709.3.1 Load test procedure specified: Where a standard listed in ***Appendix A*** contains an applicable load test procedure and acceptance criteria, the test procedure and acceptance criteria in the standard shall apply. In the absence of specific *load* factors or acceptance criteria, the *load* factors and acceptance criteria in 780 CMR 1709.3.2 shall apply.

1709.3.2 Load test procedure not specified: In the absence of applicable load test procedures contained within a standard referenced by this code or acceptance criteria for a specific material or method of construction, such existing structure shall be subjected to a test load equal to two times the design *load*. The test load shall be left in place for a period of 24 hours. The structure shall be considered to have met successfully the test requirements if all of the following criteria are satisfied:

1. Under the design *load*, the deflection shall not exceed the limitations specified by the SER;
2. Within 24 hours after removal of the test load, the structure shall have recovered not less than 75% of the maximum deflection; and
3. During and immediately after the test, the structure shall not show evidence of failure.

780 CMR 1710.0 PRECONSTRUCTION LOAD TESTS

1710.1 General: In evaluating the physical properties of materials and methods of construction which are not capable of being designed by approved engineering analysis or which do not comply with the applicable material design standards listed in ***Appendix A***, the structural adequacy shall be predetermined based on the load test criteria established by 780 CMR 1710.2 through 1710.5.

1710.2 Load test procedures specified: Where specific load test procedures, *load* factors and acceptance criteria are included in the applicable design standards listed in ***Appendix A***, such test procedures, *load* factors and acceptance criteria shall apply. In the absence of specific test procedures, *load* factors or acceptance criteria, the corresponding provisions in 780 CMR 1710.3 shall apply.

1710.3 Load test procedures not specified: Where load test procedures are not specified in the applicable design standards listed in ***Appendix A***, the loadbearing capacity of structural components and assemblies shall be determined on the basis of load tests conducted in accordance with 780 CMR 1710.3.1 and 1710.3.2. Load tests shall simulate all of the applicable *loading* conditions specified in 780 CMR 16.

1710.3.1 Test procedure: The test assembly shall be subjected to an increasing superimposed load equal to not less than two times the superimposed design *load*. The test load shall be left in place for a period of 24 hours. The tested assembly shall be considered to have met successfully the test requirements if the assembly recovers not less than 75% of the maximum deflection within 24 hours after the removal of the test load. The test assembly shall then be reloaded and subjected to an increasing superimposed load until either structural failure occurs or the superimposed load is equal to 2½ times the load at which the deflection limitations specified in 780 CMR 1710.3.2 were reached, or the load is equal to 2½ times the superimposed design *load*. In the case of structural components and assemblies for which deflection limitations are not specified in 780 CMR 1710.3.2, the test specimen shall be subjected to an increasing superimposed load until structural failure occurs or the load is equal to 2½ times the desired superimposed design *load*. The allowable superimposed design *load* shall be taken as the lesser of:

1. The load at the deflection limitation given by 780 CMR 1709.3.2;
2. The failure load divided by 2.5; or
3. The maximum load applied divided be 2.5.

1710.3.2 Deflection: The deflection of structural members under the design *load* shall not exceed the limitations in 780 CMR 1604.5.

1710.4 Wall and partition assemblies: Loadbearing wall and partition assemblies shall sustain the test load both with and without window framing. The test load shall include all design *load* components.

1710.5 Test specimens: All test specimens and construction shall be representative of the materials, workmanship and details normally used in practice. The properties of the materials used to construct the test assembly shall be determined on the basis of tests on samples taken from the load test assembly or on representative samples of the materials used to construct the load test assembly. All required tests shall be conducted or witnessed by an *approved agency*. Wall and partition assemblies shall be tested both with and without door and window framing.

NON-TEXT PAGE

CHAPTER 18

FOUNDATIONS AND RETAINING WALLS

(This Chapter is unique to Massachusetts)

780 CMR 1801.0 GENERAL

1801.1 Scope: The provisions of 780 CMR 18 shall control the foundation design and construction of all buildings and structures hereafter erected to insure adequate strength of all parts thereof for the safe support of all superimposed *live* and *special loads*, in addition to their own *dead load*, without exceeding the allowable stresses or design capabilities.

780 CMR 1802.0 FOUNDATION INVESTIGATIONS

1802.1 Where required: Borings, test pits or other soil investigations shall be required for all structures except the following, unless specifically required by the code official:

1. one- and two-family dwellings and their accessory buildings;
2. structures less than 35,000 cubic feet in gross volume; or
3. structures used for agricultural purposes.

The borings, test pits or other soil investigations shall be adequate in number and depth and so located to accurately define the nature of the subsurface materials necessary for the support of the structure. When it is proposed to support the structure directly on bedrock, the code official shall require core borings to be made into the rock; or shall require other satisfactory evidence to prove that the structure shall be adequately founded on bedrock.

1802.1.1 Seismic investigation: Where the foundation investigation indicates subsoils of Material Classes 8 or 9, as defined in Table 1804.3, a soil investigation report which evaluates the potential hazards due to liquefaction and slope instability during an earthquake shall be submitted to the code official. The liquefaction evaluation shall be performed in accordance with 780 CMR 1805.3

1802.2 Soil samples and boring reports: Samples of the strata penetrated in test borings or test pits, representing the natural disposition and conditions at the site, shall be available for examination by the code official. Wash or bucket samples shall not be accepted. Duplicate copies of the results obtained from all borings and of all test results or other pertinent soil data shall be filed with the code official.

780 CMR 1803.0 SOIL BEARING TESTS

1803.1 General: Whenever the allowable bearing pressure on bearing materials is in doubt, the code official may require soil bearing tests. The tests shall be performed under the direction of a *registered design professional*. A complete record of the test results together with a soil profile shall be filed by the *registered design professional* who shall have a representative on the site during all boring and test operations.

1803.2 Loaded areas: The loaded area shall be approximately four square feet for all bearing materials; except that when the footing overlies wet clay or other soft materials, the test load shall be applied to an area of not less than ten square feet. Bearing tests shall be applied at the elevations of the proposed bearing surfaces of the structure; except that the load may be applied directly on the surface of compacted granular material. The excavation within three feet (1 m) surrounding an area to be tested shall be made not deeper than one foot (0.3 m) above the plane of application of the test. The test plate shall be placed with uniform bearing.

1803.3 Loading procedure: The application of the test load shall be in steps equal to not more than ½ the contemplated design bearing pressure, to at least twice the contemplated design bearing pressure. The unloading shall be at least two steps, to the design pressure and then to zero load. The contemplated design pressure and twice the contemplated design pressure shall be maintained constant for at least 24 hours and until the movement does not exceed two hundredths of an inch (0.5 mm) during a 24-hour period. The load for all other load and unload steps including the zero load at the end of the test shall be maintained constant for a period of not less than four hours. Sufficient readings for each load step shall be made to define properly the time-deflection curve.

1803.4 Accuracy of loading: Test loads applied by mechanical devices shall be automatically controlled so as to insure not more than a 5% variation in applied load. Such devices shall be calibrated prior to the test.

1803.5 Test acceptance: The proposed design load shall be allowed provided that the requirements of 780 CMR 1805.5 are fulfilled and the settlements under the design bearing pressure and twice the design bearing pressure do not exceed ⅜ of an inch (10 mm) and one inch (25 mm), respectively.

780 CMR 1804.0 LOAD BEARING VALUE OF SOILS

1804.1 Soils report: All applications for permits for the construction of new buildings or structures, and for the *alteration* of permanent structures which require changes in foundation loads and distribution, shall be accompanied by a report describing the soil in the ultimate loadbearing strata, including sufficient data to establish its character, nature and loadbearing capacity. The report shall be prepared by a *registered design professional*.

1804.2 Satisfactory foundation materials: Satisfactory bearing strata to provide structural support shall be considered to include the following: natural strata of rock, gravel, sand, inorganic silt, inorganic clay, or combination of these materials provided that they do not overlie an appreciable amount of peat, organic silt, soft clay or other objectionable materials. Compacted fills, when designed and monitored by a *registered design professional*, may be accepted by the code official. Other conditions of unsatisfactory bearing materials which are improved in accordance with the recommendations of, and monitored by, a *registered design professional* may be accepted by the code official.

1804.2.1 Loading interaction: Wherever bearing strata are subject to interaction from other loadings or strata reactions, such conditions shall be incorporated in the evaluation of the design bearing capacity of the support strata.

1804.2.2 Protection of bearing strata: Bearing strata which may be adversely affected by conditions within the structure, such as evaporation and shrinkage due to excess heat or cold, shall be adequately protected.

1804.3 Presumptive load bearing values: The maximum allowable pressure on supporting soils under spread footings at or near the surface shall not exceed the values specified in Table 1804.3 or the maximum allowable pressure shall be determined by load tests conducted in the field or as otherwise provided herein. Presumptive loadbearing values shall apply to all materials with similar physical characteristics. Surface values shall be adjusted for deep footings and for weaker loadbearing strata below piles, as provided for in 780 CMR 1817.8. Higher allowable bearing pressures may be approved by the code official when substantiated by the results of investigations, analyses or testing prepared by a *registered design professional*.

1804.3.1 Classification of bearing materials: The terms used in 780 CMR 1804 shall be interpreted in accordance with generally accepted engineering nomenclature. Refer to commentary in Appendix D for guidelines regarding soil and rock classification and description.

1804.3.2 Prepared fill: Materials from Classes 6 through 8, Table 1804.3, or dense graded crushed stone or slag, which contain no plastic fines, shall have a maximum allowable bearing pressure of up to five tons per square foot when compacted to 95% or greater of the maximum dry density as determined by ASTM D1557 listed in ***Appendix A***. For compacted fills which do not meet the above criteria or materials which cannot be tested as above, a *registered design professional* shall be engaged to provide recommendations for compaction and maximum allowable design bearing pressures.

1804.3.3 Field Control: The code official will require that a *registered design professional* or his representative be on the project at all times while fill is being placed and compacted. The representative shall make an accurate record of the types of materials used, including grain-size curves, thickness of lifts, densities, percent compaction, type of compacting equipment and number of coverages, the use of water and other pertinent data.

Table 1804.3
ALLOWABLE BEARING PRESSURES FOR FOUNDATION MATERIALS

Material Class	Description	Notes	Consistency in Place[1]	Allowable Net Bearing Pressure (tons/ft^2)
1a	Massive bedrock: Granite, diorite gabbro, basalt, gneiss	3	Hard, sound rock, minor jointing	100
1b	Quartzite, well cemented conglomerate	3	Hard, sound rock moderate jointing	60
2	Foliated bedrock: slate, schist	3	Medium hard rock, minor jointing	40
3	Sedimentary bedrock: cementation shale, siltstone, sandstone, limestone, dolomite, conglomerate	3, 4	Soft rock, moderate jointing	20
4	Weakly cemented sedimentary bedrock: compaction shale or other similar rock in sound condition	3	Very soft rock	10
5	Weathered bedrock: any of the above except shale.	3, 5	Very soft rock, weathered and/or major jointing and fracturing	8
6	Slightly cemented sand and/or gravel, glacial till (basal or lodgement), hardpan	7,8	Very dense	10
7	Gravel, widely graded sand and gravel; and granular ablation till	6, 7, 8	Very dense Dense Medium dense Loose Very loose	8 6 4 2 Note 11
8	Sands and non-plastic silty sands with little or no gravel (except for Class 9 materials)	6, 7, 8, 9	Dense Medium dense Loose Very loose	4 3 2 Note 11
9	Fine sand, silty fine sand, and non-plastic inorganic silt	6, 7, 9	Dense Medium dense Loose Very loose	3 2 1 Note 11
10	Inorganic sandy or silty clay, clayey sand, clayey silt, clay, or varved clay; low to high plasticity	5, 6, 10	Hard Stiff Medium Soft	4 2 1 Note 11
11	Organic soils: peat, organic silt, organic clay	11		Note 11

Notes for Table 1804.3:

1. Refer to commentary in Appendix D regarding typical index test values that may be helpful as guides for evaluation of consistency in place.
2. Refer to 780 CMR 1807.0 for determination of design loads and for special cases.
3. The allowable bearing pressures may be increased by an amount equal to 10% for each foot of depth below the surface of sound rock; however, the increase shall not exceed two times the value given in the table.
4. For limestone and dolomite, the bearing pressures given are acceptable only if an exploration program performed under the direction of a *registered design professional* demonstrates that there are no cavities within the zone of influence of the foundations. If cavities exist, a special study of the foundation conditions is required.
5. Weathered shale and/or weathered compaction shale shall be included in Material Class 10. Other highly weathered rocks and/or residual soils shall be treated as soil under the appropriate description in Material Classes 6 to 10. Where the transition between residual soil and bedrock is gradual, a *registered design professional* shall make a judgment as to the appropriate bearing pressure.
6. Settlement analyses in accordance with 780 CMR 1805.5 should be performed if the ability of a given structure to tolerate settlements is in question, particularly for, but not limited to, soft or very soft clays and silts and loose granular materials.
7. Allowable bearing pressures may be increased by an amount equal to 5% for each foot of depth of the bearing area below the minimum required in 780 CMR 1806.0; however, the bearing pressure shall not exceed two times the value given in the table. For foundation bearing areas having a least lateral dimension smaller than three feet, the allowable bearing pressure shall be ⅓ of the tabulated value times the least dimension in feet.
8. Refer to 780 CMR1804.3 when these materials are used as compacted fills.
9. These materials are subject to the provisions in 780 CMR 1805.3 (Liquefaction).

10 Alternatively, the allowable bearing pressure may be taken as 1.5 times the peak unconfined compressive strength of undisturbed samples for square and round footings or 1.25 times that strength for footings with length to width ratio of 4 or greater. For intermediate cases, interpolation may be used.

11. A *registered design professional* shall be engaged to provide recommendations for these special cases. Direct bearing on organic soils is not permitted. Organic soils are allowed under foundations for those cases defined in 780 CMR 1804.4.2, Preloaded materials.

1804.4 Lightweight structures: One-story structures without masonry walls and not exceeding 800 square feet in area may be founded on a layer of satisfactory bearing material not less than three feet (1 m) thick, which is underlain by highly compressible material, provided that the stresses induced in the unsatisfactory material by the *live* and *dead loads* of the structure, and the weight of any new fill within or adjacent to the building area, will not exceed 250 pounds per square foot (250 psf).

1804.4.1 Bearing capacity for lightweight structures: Lightweight structures and accessory structures, such as garages and sheds, may be founded on normally unacceptable bearing strata, providing such material is determined by a *registered design professional* as being satisfactory for the intended use.

1804.4.2 Preloaded materials: The code official may allow the use of certain otherwise unsatisfactory natural soils and uncompacted fills for support of one-story structures after these materials have been preloaded to effective stresses not less than 150% of the effective stresses which will be induced by the live and *dead loads* of the structure.

1804.4.3 Load test: The code official may require the loading and unloading of a sufficiently large area, conducted under the direction of a *registered design professional* approved by the code official, who shall submit a report containing a program which will allow sufficient time for adequate consolidation of the material based on an analysis of the preloaded material and of the probable settlements of the structure.

780 CMR 1805.0 ALLOWABLE FOUNDATION LOADS

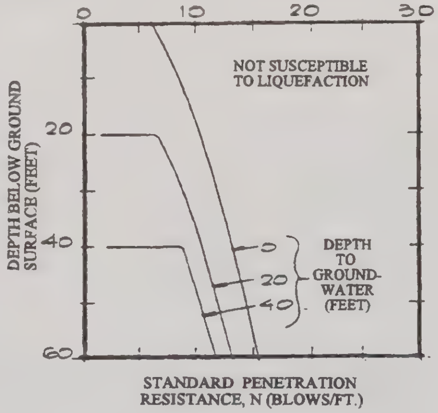
1805.1 General: The maximum allowable pressures on foundation materials shall be in accordance with 780 CMR 1804.0 and as modified herein.

1805.2 Soil Capacity: For the load combinations, including seismic as specified in 780 CMR 1616.0, the soil loadbearing strength shall be sufficient to resist loads at acceptable strain, considering both the duration of the loading and the dynamic properties of the soil. For foundations supported on or in Material Classes 1 through 6, as defined in Table 1804.3, or medium dense to very dense soils of Material Classes 7 through 9, or stiff to hard soil of Materials Class 10, the allowable bearing pressure or pile or pier capacity may be increased by up to 33% for load combinations that include wind or seismic loading.

1805.3 Liquefaction:

1. The earthquake liquefaction potential of saturated clean medium to fine sands shall be evaluated on the basis of Figure 1805.3 for cases where lateral sliding cannot occur.

Figure 1805.3
LIQUEFACTION SUSCEPTABILITY



If the standard resistances, N, in all strata of medium to fine sand lie above the applicable curve in Figure 1805.3 the sands at the site shall not be considered subject to liquefaction. Liquefaction below a depth of 60 feet (18 m) from final grade need not be considered for level ground. For pressure-injected footings, the ten-foot (3-m) thickness of soil immediately below the bottom of the driven shaft shall not be considered subject to liquefaction.

2. Compacted granular fills shall not be considered subject to liquefaction provided they are systematically compacted to at least 93% of maximum dry density as determined in accordance with ASTM Standard Method D1557, listed in ***Appendix A*** or to a relative density of at least 60% in the case of granular soils having less than 10% by weight material passing the No. 200 U.S. Sieve.

3. For sites not meeting the above criteria, studies by a *registered design professional* shall be made to determine that the structural loads can be safely supported. Such studies might include the following:

   - Investigations to establish that the soils at the site are not subject to liquefaction during the design earthquake as specified in 780 CMR 1612.0.

- Design of foundations that will not fail either by loss of bearing capacity or excessive settlement if liquefaction occurs.
- Replacement or densification of liquefaction-susceptible soils such that liquefaction will not occur.

4. For sites underlain by saturated sands where lateral sliding (slope instability) may occur, studies by a *registered design professional* shall be made to establish the safety against sliding during an earthquake with a peak acceleration of 0.12 g and a frequency content similar to that implied by the modal seismic design coefficient set forth in 780 CMR 1612.0
5. For sites underlain by saturated silty sands and inorganic non-plastic silts, studies shall be made by a *registered design professional* to determine the susceptibility to liquefaction of these soils.

1805.4 Vertical pressure: The computed vertical pressure at any level beneath a foundation shall not exceed the allowable bearing pressure for the material at that level. Computation of the vertical pressure in the bearing materials at any depth below a foundation shall be made on the assumption that the load is spread uniformly at an angle of 30° with the vertical; but the area considered as supporting the load shall not extend beyond the intersection of 30° planes of adjacent foundations.

1805.5 Settlement analysis: Whenever a structure is to be supported by medium or soft clay (materials of Class 10) or other materials which may be subject to settlement or consolidation, the settlements of the structure and of neighboring structures due to consolidation shall be given careful consideration, particularly if the subsurface material or the loading is subject to significant variation. The code official may require a settlement analysis to be made by a *registered design professional* when the *live* and *dead loads* of the structure, as specified in this article, minus the weight of the excavated material, induce a maximum stress greater than 300 pounds per square foot at mid-depth of the underlying soft soil layer.

Settlement analysis will be based on a computation of the new increase in stress that will be induced by the structure and realistically appraised *live loads*, after deducting the weight of excavated material under which the soil was fully consolidated. The effects of fill loads within the building area or fill and other loads adjacent to the building shall be included in the settlement analysis. The appraisal of the *live loads* may be based on surveys of actual *live loads* of existing buildings with similar occupancy. The soil compressibility shall be determined by a *registered design professional.*

1805.6 Disturbance of bearing materials: Whenever the bearing materials are disturbed from any cause, for example, by the inward or upward flow of water and/or by construction activities, the extent of the disturbance shall be evaluated by a *registered design professional* and appropriate remedial measures satisfactory to the code official shall be taken.

1805.7 Rock foundations: Where subsurface explorations at the project site indicate variations or doubtful characteristics in the structure of the rock upon which it is proposed to construct foundations, a sufficient number of borings shall be made to a depth of not less than ten feet below the level of the foundations to provide assurance of the soundness of the foundation stratum and its bearing capacity. Refer to Table 1804.3 for allowable bearing pressures and special conditions.

The maximum presumptive loadbearing capacity of Class 1 or Class 2 rock may be increased where the surface is leveled or benched, provided that such increased safe capacity is determined by load tests on an area of not less than one square foot (0.093 m^2) in accordance with the provisions of 780 CMR 1803.0.

780 CMR 1806.0 DEPTH OF FOOTINGS

1806.1 Frost protection: All permanent supports of buildings and structures larger than 100 square feet (9.3 m^2) in area or ten feet (3 m) in height shall extend to a minimum of four feet (1.2 m) below finished grade except when erected upon sound bedrock or when protected from frost, or when the foundation grade is established by a *registered design professional* and as approved by the code official. Spread footings of adequate size shall be provided where necessary to distribute properly the load within the allowable load bearing value of the soil. Footings shall not bear on frozen soils.

1806.2 Isolated footings: Footings on granular soil of Classes 7, 8 and 9 of Table 1804.3 and compacted fill shall be so located that the line drawn between the lower edges of adjoining footings shall not have a steeper slope than 30° (0.52 rad) with the horizontal unless the material supporting the higher footing is braced or retained or otherwise laterally supported in an approved manner or a greater slope has been properly established by a *registered design professional.*

1806.3 Depth of spread foundations: The bottom surface of any footing resting on material of Classes 5 through 10 of Table 1804.3, shall be at least 18 inches (460 mm) below the lowest ground surface or the top surface of a floor slab bearing directly on the soil immediately adjacent to the footing.

780 CMR 1807.0 FOOTING DESIGN

1807.1 Design loads: The loads to be used in computing the pressure upon bearing materials directly underlying foundations shall be the *live* and *dead loads* of the structure, as specified in 780 CMR 1616.0 including the weight of the foundations and of any immediately overlying material, but deducting from the resulting pressure per square foot the total weight of a one-foot-square column of soil, including the water in its voids, which extends from the lowest immediately adjacent surface of the soil to the bottom of the footing, pier or mat. Foundations shall be constructed so as to resist the maximum probable hydrostatic pressures.

1807.2 Vibratory loads: Where machinery operations or other vibrations are transmitted through the foundation, consideration shall be given in the footing design to prevent detrimental disturbances of the soil.

1807.3 Varying unit pressures: Footings shall be so designed that the unit soil pressure under the *dead load* shall be as uniform as possible under all parts of the building structure. When necessary for stability in the structure due to settlement or varying soil conditions, approved variations are permitted in the unit pressure under different footings.

1807.4 Eccentric loads: Eccentricity of loadings in foundations shall be fully investigated, and the maximum pressure on the basis of straight-line distribution shall not exceed the allowable bearing pressures.

1807.5 Protection of footings: Trenching installed parallel to footings shall not extend below the line of a 45° (0.79 rad) angle downward from the loadbearing plane of the footing.

780 CMR 1808.0 TIMBER FOOTINGS AND WOOD FOUNDATIONS

1808.1 Timber footings: Timber footings are permitted for buildings of Type 5 construction and as otherwise approved. Such footings shall be treated in accordance with AWPA C2 or C3 listed in *Appendix A*. Treated timbers are not required where placed entirely below permanent water level, or where used as capping for wood piles which project above the water level over submerged or marsh lands. The compressive stresses perpendicular to grain in untreated timber footings supported upon piles shall not exceed 70% of the allowable stresses for the species and grade of timber as specified in NFoPA NDS listed in *Appendix A*.

1808.2 Pole buildings: Pole-type buildings shall be designed and erected in accordance with AWPI *Pole Building Design* listed in *Appendix A*. The poles shall be treated in accordance with AWPA C2 or C4 listed in *Appendix A*.

1808.3 Wood foundations: Wood foundation systems shall be designed and installed in accordance with NFoPA TR7 listed in *Appendix A*. All lumber and plywood shall be treated in accordance with AWPA C22 listed in *Appendix A* and shall be identified in accordance with 780 CMR 2311.3.1.

780 CMR 1809.0 STEEL GRILLAGES

1809.1 General: All steel grillage beams shall be separated with approved steel spacers and shall be entirely encased in at least three inches (76 mm) of concrete, and the spaces between the beams shall be completely filled with concrete or cement grout. Where used on yielding soils, steel grillages shall rest on approved concrete beds not less than six inches (152 mm) thick.

780 CMR 1810.0 CONCRETE FOOTINGS

1810.1 Concrete strength: Concrete in footings shall have a specified compressive strength of not less than 2,500 psi (1.76 kg/mm^2) at 28 days.

1810.2 Design: Concrete footings shall comply with 780 CMR 19 and ACI 318 or ACI 318.1 listed in *Appendix A*.

1810.2.1 Footing seismic ties: Individual spread footings, located on soil profile type S2, S3 or S4, in accordance with 780 CMR 1612.4.2, and supporting buildings assigned to *Seismic Performance Category D*, in accordance with 780 CMR 1612.2.7, shall be interconnected by ties. All ties shall be capable of resisting, in tension or compression, a force equal to 10% of the larger column *dead plus live load*. Individual tie beams are not required when it is demonstrated that equivalent restraint will be provided by structural members within slabs on grade or reinforced concrete slabs on grade or confinement be competent rock, hard cohesive soils, very dense granular soils or other approved means.

1810.3 Thickness: The thickness of concrete footings shall comply with 780 CMR 1810.3.1 and 1810.3.2.

1810.3.1 Plain concrete: In plain concrete footings, the edge thickness shall not be less than eight inches (203 mm) for footings on soil; except that for occupancies of Use Group R-3 and buildings less than two stories in *height* of Type 5 construction, the required edge thickness shall be six inches (152 mm) provided that the footing does not extend beyond four inches (102 mm) on either side of the supported wall.

1810.3.2 Reinforced concrete: In reinforced concrete footings, the thickness above the bottom reinforcement shall not be less than six inches (152 mm) for footings on soil. The clear cover on reinforcement where the concrete is cast against the earth shall not be less than three inches (76 mm). Where concrete is exposed to soil after it has been cast, the clear cover shall not be less than 1½ inches (38 mm) for reinforcement of No. 5 bars or ⅝-inch (16 mm) diameter wire or smaller, nor less than two inches (51 mm) for larger reinforcement.

1810.4 Deposition: Concrete footings shall not be placed through water unless otherwise approved. Where placed under or in the presence of water, the concrete shall be deposited by approved means to insure minimum segregation of the mix and negligible turbulence of the water.

1810.5 Protection of concrete: Concrete footings shall be protected from freezing during depositing and for a period of not less than five days thereafter. Water shall not be allowed to flow through the deposited concrete.

1810.6 Forming of concrete: Concrete footings shall not be cast against the earth where, in the opinion of the code official, soil conditions warrant forming. Where forming is required, forming shall be in accordance with Chapter 6 of ACI 318 listed in ***Appendix A***.

780 CMR 1811.0 MASONRY-UNIT FOOTINGS

1811.1 Dimensions: Masonry-unit footings shall be laid in Type M or S mortar complying with 780 CMR 2105.7, and the depth shall not be less than twice the projection beyond the wall, pier or column. The width shall not be less than eight inches (203 mm) wider than the wall supported thereon.

1811.2 Offsets: The maximum offset of each course in brick foundation walls stepped up from the footings shall be 1½ inches (38 mm), if laid in single courses, and three inches (76 mm), if laid in double courses.

780 CMR 1812.0 FOUNDATION WALLS

1812.1 Design: Foundation walls shall be designed to resist frost action and to support safely all vertical and *lateral loads* as provided for in 780 CMR 16. The maximum stresses caused by combined loads shall be within the values specified for the materials used in the construction. Unless properly reinforced, tensile stresses shall not exceed those permitted in plain masonry.

1812.2 Definitions: The following words and terms shall, for the purposes of 780 CMR 1812 and as used elsewhere in 780 CMR, have the meanings shown herein.

Foundation wall: A wall below the floor nearest grade which serves as a support for a wall, pier, column or other structural part of a building.

Retaining wall: A wall designed to resist the lateral displacement of soil or other material.

1812.3 Minimum thickness: The thickness of foundation walls shall not be less than the thickness of the wall supported, and the minimum thickness shall be limited for the various materials of construction as herein specified. Eight-inch foundation walls shall be permitted under brick-veneered frame and under ten-inch cavity walls where the total height of the wall supported, including gables, is not more than 20 feet (6 m).

1812.3.1 Reinforced concrete: Reinforced concrete exterior foundations and exterior and interior *basement* walls which retain or support the lateral pressure of earth or water shall not be less than 7½ inches (191 mm) thick.

1812.3.2 Hollow and solid masonry and plain concrete: The thickness of masonry foundation walls shall not be less than shown in Table 1812.3.2 for the type of foundation used. Where the height of the unbalanced fill (height of finished ground level above the *basement* floor or inside ground level) exceeds eight feet (2.4 m) or where the equivalent fluid weight of the unbalanced fill exceeds 30 pounds per cubic foot (pcf) (146 kg/m^3) or where the height of the foundation wall between lateral supports exceeds eight feet (2.4 m), the foundation wall thickness shall be determined by structural analysis in accordance with ACI 530/ASCE 5/ TMS 402 or ACI 318.1 listed in ***Appendix A***.

Table 1812.3.2
THICKNESS OF FOUNDATION WALLS

Foundation wall construction	Thickness[b] (inches)	Maximum depth of unbalanced fill[a] (feet)
Masonry of hollow units Ungrouted	8	4
	10	5
	12	6
Masonry of hollow units, reinforced vertically with #4 bars and grout at 24" o.c. Bars located not less than 4½" from pressure side of wall[c,d]	8	7
Masonry of solid units	8	5
	10	6
	12	7
Plain concrete or masonry of hollow or solid units, fully grouted	8	7
	10	8
	12	8

Note a. Maximum depths of unbalanced fill shall be permitted to be increased with the approval of the code official where soil conditions or local experience warrant such increase.

Note b. The actual thickness shall not be more than ½ inch less than the required nominal thickness specified in the table.

Note c. Other bar sizes and spacings shall be permitted as determined by structural analysis as required in ACI 530/ASCE 5/TMS 402 listed in ***Appendix A***.

Note d 1 inch = 25.4 mm; 1 foot = 304.8 mm.

1812.3.3 Hollow-unit walls: Foundation walls of approved hollow masonry units shall be provided with not less than four inches (102 mm) of solid masonry at girder supports, or shall be strengthened with buttresses.

1812.3.4 Rubble stone: Foundation walls of rough or random rubble stone shall not be less than 16 inches (406 mm) thick.

1812.3.5 Bonding: All foundation walls shall be bonded as required for superstructure walls in 780 CMR 2110.0.

1812.4 Increased thickness with depth: Where any foundation wall, other than a wall that is designed as a retaining wall, extends more than 12 feet (3.7 m) below the top of the first floor beams, the thickness of the wall shall be increased four inches (102 mm) for each additional 12 feet (3.7 m) or fraction thereof in depth.

1812.5 Corbels on eight-inch walls: Where an eight-inch (203 mm) wall is corbelled, the top corbel shall be a full course of headers at least six inches (152 mm) in length, extending not higher than the bottom of the floor framing. The maximum projection of one unit shall exceed neither ½ of the depth of the unit nor ⅓ of its width at right angles to the face which is offset.

1812.6 Lateral stability: Foundation walls of buildings and structures which serve as retaining walls shall conform to the applicable requirements of 780 CMR 1825.0, and shall be strengthened with buttresses or additional wall thickness to resist lateral soil and hydrostatic pressure where subjected thereto, and to resist seismic loads as required by 780 CMR 1612.4.9.

780 CMR 1813.0 WATERPROOFING AND DAMPPROOFING

1813.1 Where required: Walls or portions thereof that retain earth and enclose interior spaces and floors below grade shall be waterproofed and dampproofed in accordance with 780 CMR 1813.0, with the exception of those spaces containing use groups other than residential and institutional where such omission is not detrimental to the building or occupancy.

1813.1.1 Story above grade: Where a *basement* is considered a *story above grade* and the finished ground level adjacent to the *basement* wall is below the *basement* floor elevation for 25% or more of the perimeter, the floor and walls shall be dampproofed in accordance with 780 CMR 1813.3 and a foundation drain shall be installed in accordance with 780 CMR 1813.5.2. The foundation drain shall be installed around the portion of the perimeter where the *basement* floor is below ground level. The provisions of 780 CMR 1813.2, 1813.4 and 1813.5.1 shall not apply in this case.

1813.1.2 Underfloor space: The finished ground level of an underfloor space such as a crawl space shall not be located below the bottom of the footings. Where there is evidence that the ground water table rises to within six inches (152 mm) of the ground level at the outside building perimeter or where there is evidence that the surface water does not readily drain from the building site, the ground level of the underfloor space shall be as high as the outside finished ground level, unless an approved drainage system is provided. The provisions of 780 CMR 1813.2, 1813.3, 1813.4, 1813.5 and 1813.6 shall not apply in this case.

1813.2 Ground water table investigation: The owner or applicant shall perform a subsurface soil investigation in accordance with 780 CMR 1802.0 to determine the possibility of the ground water table rising above the proposed elevation of the floor or floors below grade.

Exception: A subsurface soil investigation shall not be required where:

1. Waterproofing is to be provided;
2. Satisfactory data from adjacent areas are available which demonstrate that ground water has not been a problem; or
3. Floodproofing is to be provided in accordance with 780 CMR 3107.0.

1813.2.1 Ground water control: Where the ground water table is lowered and maintained at an elevation not less than six inches (152 mm) below the bottom of the lowest floor, the floor and walls shall be dampproofed in accordance with 780 CMR 1813.3. The design of the system to lower the ground water table shall be based upon accepted principles of engineering which shall consider, but not necessarily be limited to: permeability of the soil; rate at which water enters the drainage system; rated capacity of pumps; head against which pumps are to pump; and the rated capacity of the disposal area of the system. The design shall also take into account any adverse impacts on utilities, structures or other facilities in the vicinity which would result from the lowering of groundwater levels.

1813.3 Dampproofing required: Where hydrostatic pressure will not occur as determined by 780 CMR 1813.2, floors and walls for other than wood foundation systems shall be dampproofed in accordance with 780 CMR 1813.0. Wood foundation systems shall be constructed in accordance with NFoPA TR7 listed in ***Appendix A***.

1813.3.1 Floor applications: The required dampproofing materials shall be installed between the floor and the base course required by

780 CMR 1813.5.1, except where a separate floor is provided above a concrete slab.

1813.3.1.1 Floor dampproofing materials: Where installed beneath the slab, dampproofing shall consist of not less than 6-mil (.006 inch; 152 μm) polyethylene with joints lapped not less than six inches (152 mm), or other approved methods or materials. Where permitted to be installed on top of the slab, dampproofing shall consist of mopped-on bitumen, not less than 4-mil (.004 inch; 102 μm) polyethylene, or other approved methods or materials. Joints in the membrane shall be lapped and sealed in accordance with the manufacturer's installation instructions.

1813.3.2 Walls: Dampproofing materials shall be installed on the exterior surface of walls and shall extend from the top of the footing to above ground level.

1813.3.2.1 Surface preparation of walls: Prior to application of dampproofing materials on concrete walls, all holes and recesses resulting from the removal of form ties shall be sealed with a bituminous material or other approved methods or materials. Unit masonry walls shall be parged on the exterior surface below ground level with not less than ⅜ inch (10 mm) of portland cement mortar. The parging shall be coved at the footing.

Exception: Parging of unit masonry walls is not required where a material is approved for direct application to the masonry.

1813.3.2.2 Wall dampproofing materials: Dampproofing shall consist of a bituminous material, three pounds per square yard of acrylic modified cement, ⅛-inch coat of surface-bonding mortar complying with ASTM C887 listed in ***Appendix A***, any of the materials permitted for waterproofing by 780 CMR 1813.4.2.2, or other approved methods or materials.

1813.4 Waterproofing required: Where the ground water investigation required by 780 CMR 1813.2 indicates that a hydrostatic pressure condition exists, walls and floors shall be waterproofed in accordance with 780 CMR 1813.4.

1813.4.1 Floors: Floors required to be waterproofed shall be of concrete, designed and constructed to withstand the hydrostatic pressures to which the floors will be subjected.

1813.4.1.1 Floor waterproofing materials: Waterproofing shall be accomplished by placing a membrane of rubberized asphalt, butyl rubber, neoprene, or not less than 6-mil (.006 inch; 152 μm) polyvinyl chloride or polyethylene with joints lapped not less than six inches (152 mm) or other approved materials under the slab. Joints in the membrane shall be lapped and sealed in accordance with the manufacturer's installation instructions.

1813.4.2 Walls: Walls required to be waterproofed shall be of concrete or masonry and shall be designed and constructed to withstand the hydrostatic pressures and other *lateral loads* to which the walls will be subjected.

1813.4.2.1 Surface preparation of walls: Prior to the application of waterproofing materials on concrete or masonry walls, the walls shall be prepared in accordance with 780 CMR 1813.3.2.1.

1813.4.2.2 Wall waterproofing materials: Waterproofing shall be applied from the bottom of the wall to not less than 12 inches (305 mm) above the maximum elevation of the ground water table. The remainder of the wall shall be dampproofed in accordance with 780 CMR 1813.3.2.2. Waterproofing shall consist of two-ply hot-mopped felts, not less than 6-mil (.006-inch; 152-μm) polyvinyl chloride, 40-mil (.040-inch; 1 mm) polymer-modified asphalt, 6-mil (.006-inch; 152-μm) polyethylene or other approved methods or materials capable of bridging nonstructural cracks. Joints in the membrane shall be lapped and sealed in accordance with the manufacturer's installation instructions.

1813.4.3 Joints and penetrations: Joints in walls and floors, joints between the walls and floor, and penetrations of the wall and floor shall be made water tight utilizing approved methods and materials.

1813.5 Subsoil drainage system: Where a hydrostatic pressure condition does not exist, dampproofing shall be provided and a base shall be installed under the floor and a drain installed around the foundation perimeter. A subsoil drainage system designed and constructed in accordance with 780 CMR 1813.2.1 shall be deemed adequate for lowering the groundwater table.

1813.5.1 Floor base: Floors of *basements*, except as provided for in 780 CMR 1813.1.1, shall be placed over a base course not less than four inches (102 mm) in thickness that consists of gravel or crushed stone containing not more than 10% of material that passes through a No. 4 sieve.

Exception: Where a site is located in well-drained gravel or sand/gravel mixture soils, a floor base is not required.

1813.5.2 Foundation drain: A drain shall be placed around the perimeter of a foundation that consists of gravel or crushed stone containing not more than 10% material that passes through a No. 4 sieve. The drain shall extend a minimum of

12 inches (102 mm) beyond the outside edge of the footing. The thickness shall be such that the bottom of the drain is not higher than the bottom of the base under the floor, and that the top of the drain is not less than six inches (152 mm) above the top of the footing. The top of the drain shall be covered with an approved filter membrane material. Where a drain tile or perforated pipe is used, the invert of the pipe or tile shall not be higher than the top of the lowest floor elevation. The top of joints shall be protected with an approved filter membrane material. The pipe or tile shall be placed on not less than two inches (51 mm) of gravel or crushed stone complying with 780 CMR 1813.5.1, and shall be covered with not less than six inches (152 mm) of the same material.

1813.5.3 Drainage disposal: The floor base and foundation perimeter drain shall discharge by gravity or mechanical means into an approved drainage system that complies with the plumbing code (248 CMR) listed in ***Appendix A***.

Exception: Where a site is located in well-drained gravel or sand/gravel mixture soils, a dedicated drainage system is not required.

1813.6 Placement of backfill: The excavation outside the foundation shall be backfilled with soil that is free of organic material, construction debris and large rocks. The backfill shall be placed in lifts and compacted in a manner which does not damage the foundation, the waterproofing or the dampproofing material.

1813.7 Site grading: The ground immediately adjacent to the foundation shall be sloped away from the building at a slope of not less than one unit vertical in 12 units horizontal (1: 12) for a minimum distance of eight feet (2.4 m) measured perpendicular to the face of the wall or an approved alternate method of diverting water away from the foundation shall be used. The procedure utilized to establish the final ground level adjacent to the foundation shall account for all additional settlement of the backfill.

1813.8 Erosion protection: Where water impacts the ground from the edge of the roof, downspout, scupper or other rainwater collection or diversion device, provisions shall be made to prevent soil erosion and direct the water away from the foundation.

780 CMR 1814.0 MAT, RAFT AND FLOAT FOUNDATIONS

1814.1 General: Mat, raft and float foundations shall only be used where the applied loads of the building or structure are so arranged as to result in practically uniformly balanced loading, and the soil immediately below the mat is of uniform loadbearing capacity. The characteristics of the soil under the mat or raft shall be considered in the analysis of loading on mats and other continuous footings, and due allowance shall be made for possible concentrated soil pressures under heavily loaded columns.

1814.2 Settlement Analysis: The design of floating foundations shall include a settlement analysis in accordance with the provisions on 780 CMR 1805.5.

780 CMR 1815.0 PIER FOUNDATIONS

1815.1 General: A foundation pier is here defined as a structural member which extends to satisfactory bearing materials to develop support by end bearing and/or friction in those materials. The pier shall be constructed by advancing a hole to the required depth using non-displacement methods and filling the hole with reinforced or plain concrete. 780 CMR 1815.0 includes foundation types referred to as drilled piers, drilled shafts and caissons, including both circular and non-circular foundation elements. Uncased piles installed by the hollow stem auger method are included in 780 CMR 1820.2, Augered uncased piles.

The minimum dimension of the pier shall be no less than 12 inches (305 mm). The base may be enlarged by belling to increase the bearing area.

1815.1.1 Special types of piers: Types of piers not specifically covered by the provisions of 780 CMR 1815.0 may be permitted, subject to the approval of the code official, upon the submission of acceptable test data and design and construction information prepared by a *registered design professional* stating that the pier installation is adequate to fulfill the design requirements.

1815.2 Seismic design:

1815.2.1 Foundation ties: Pier foundations shall be interconnected by ties capable of resisting, in tension or compression, a force equal to 10% of the larger column *dead* plus *live load*. Individual tie beams are not required when it is demonstrated that equivalent restraint will be provided by structural members within slabs on grade or reinforced concrete slabs on grade or confinement by competent rock, hard cohesive soils, dense granular soils or other approved means.

1815.2.2 Seismic reinforcement: Cast in place concrete piers shall have minimum reinforcement of 0.25% of the minimum pier design cross-sectional area for buildings assigned to *Seismic Performance Category C*, and a minimum reinforcement of 0.50% for buildings assigned to *Seismic Performance Category D* in accordance with 780 CMR 1612.2.7. The minimum pier design cross-sectional area is that area determined in accordance with 780 CMR 1815.6. (The actual constructed cross-sectional area may be larger.) The reinforcing shall be placed in the top ⅓ of the pier length or extend ten feet (3 m) from the top of the pier, whichever is the longer length.

For *Seismic Performance Category C* buildings, the pier reinforcing shall be a minimum of four longitudinal bars with closed ties, or equivalent spirals, having a minimum diameter of ¼ inch. The ties shall be provided at a maximum spacing of 16 times the longitudinal reinforcing bar diameter and shall enclose an area of concrete sufficient to confine the minimum design cross-sectional concrete area. The maximum tie spacing in the top two feet (0.6 m) of the pier length shall be four inches (102 mm). Tie detailing shall be in accordance with 780 CMR 1903.4.

For *Seismic Performance Category D* buildings, the pier reinforcing shall be a minimum of four longitudinal bars with closed ties, or equivalent spirals, having a minimum diameter of ⅜ inch, for piers with a diameter of 20 inches (508 mm) or less; and a minimum tie diameter of ½ inch, for piers with a diameter more than 20 inches (508 mm). The ties shall be provided at a maximum spacing of eight times the longitudinal reinforcing bar diameter. The maximum tie spacing in the top four feet (1.2 m) of the pier length shall be three inches (76 mm). Tie detailing shall be in accordance with 780 CMR 1903.5.

Exception: Pier ties or spirals are not required where permanent metal casing (steel pipe, steel tube or spiral-welded steel shell) is used, provided the casing has minimum thickness as follows: for *seismic Performance Category C* buildings, 0.058 inch (1.5 mm), and for *Category Performance Category D* buildings, 0.070 inch (1.8 mm). The steel casing must be adequately protected from corrosion due to soil, changing water levels, or other subgrade conditions indicated by the site soil investigation.

1815.2.3 Pier cap connection: All piers shall be connected to the pier cap so that pier reinforcement is embedded in the cap for a distance equal to the development length as specified in ACI 318 listed in ***Appendix A***. Field-placed dowels anchored in the concrete piers are acceptable. The development length to be provided is the full development length of the reinforcement for compression without reduction in length for excess area.

1815.2.4 Alternative detailing: Alternative measures for laterally confining concrete and maintaining toughness and ductile-like behavior at the top of the pier shall be permitted provided consideration is given to forcing the hinge to occur in the confined region.

1815.3 Installation: In unstable soils, a temporary casing or slurry shall be used to stabilize the excavation. When a slurry is used to stabilize the excavation, the level and quality of the slurry shall be monitored and controlled to maintain stability of the shaft and the bearing surface.

1815.4 Enlarged bases: Bell-shaped bases shall have a minimum edge thickness of four inches (102 mm). The bell roof shall slope not less than 60° with the horizontal unless the base is designed in accordance with ACI 336 listed in ***Appendix A*** (hereinafter ACI 336).

1815.5 Placement of concrete: Concrete may be dropped into the pier from the ground surface provided no more than three inches (76 mm) of water remains in the bottom and the concrete will free-fall vertically without obstruction. The concrete shall be placed in a rapid, continuous operation and controlled such that the concrete does not segregate.

1815.5.1 No piers shall be installed near a concreted pier until the concrete has set sufficiently to avoid damage to the concreted pier.

1815.5.2 For piers without enlarged bases, concrete or grout may be placed through still water or slurry. A properly operated tremie or pumping method shall be used. Samples of the slurry shall be tested to determine the properties prior to placing concrete in each pier. The quality, consistency, and density of the slurry shall be controlled to ensure that there will be free-flow of concrete from the tremie pipe. The concrete must be placed such that all water, slurry and contaminated concrete below design cutoff level is displaced.

1815.5.3 For piers with enlarged bases, the concrete may be placed under slurry, based upon the recommendations of a *registered design professional* and with the approval of the code official. The specific soil or rock conditions, equipment and procedures used shall be taken into account.

1815.5.4 A suitable method shall be employed to verify that the entire length of the shaft is completely filled with concrete. Such means shall include the ability to determine the incremental volumes of concrete installed in relation to calculated shaft volume.

1815.6 Design stresses: Foundation piers may be designed as concrete columns with continuous lateral support below the soil level. The unit compressive stress in the concrete shall not exceed 33% of the 28 day strength of the concrete or 1,600 psi, whichever is less. The unit compressive stress in the steel reinforcement or the permanent steel casing shall not exceed 40% of the yield strength of the steel or 24,000 psi, whichever is less. Permanent steel casing which is used as structural reinforcement shall be protected against corrosion in accordance with 780 CMR 1816.4.1.

1815.7 Alignment: When the center of the cross section of a foundation pier at any level deviates from the resultant of all forces more than 1/50 of its height, or more than 1/10 of its diameter, it shall be reinforced as provided in ACI 336. The restraining effect of the surrounding soil may be taken into account.

1815.8 Allowable bearing pressure: The allowable bearing pressure on the bottom of the pier shall be in accordance with 780 CMR 1804.3 Additional load may be carried by using higher bearing pressures than allowed by 780 CMR 1804.3 and/or by friction on the sides of the pier embedded in suitable bearing material based on recommendations by a *registered design professional* and subject to the approval of the code official. Such recommendations shall be based on the results of load tests or other suitable tests or analyses carried out to measure side friction and/or end bearing of piers installed in the same bearing stratum.

1815.9 Minimum spacing: The minimum center-to-center spacing between adjacent piers designed for friction support shall be not less than two times the shaft diameter.

1815.10 Special provisions: For piers with shaft diameter less than 24 inches (610 mm), the following special provisions shall apply:

1815.10.1 For piers with temporary casing extending to the bottom, the concrete may be poured from the top in accordance with 780 CMR 1815.5.

1815.10.2: For all other cases, piers shall be filled from the bottom upward through a tremie or concrete pump tube in accordance with 780 CMR 1815.5.2

1815.11 Records: The owner shall engage a *registered design professional* to monitor the installation of the piers. The design professional or his representative, qualified by training and experience, shall be present at all times while foundation piers are being installed, to observe and test the bearing material in place, to verify the pier dimensions and to observe concrete placement. When direct inspection of the bearing surface is impossible, a suitable method shall be employed to verify the condition of the bearing material and to make the measurements and tests. Records of all observations, tests and dimensions shall be signed by the *registered design professional* and a copy shall be filed in the office of the code official.

780 CMR 1816.0 PILE FOUNDATIONS

1816.1 Investigation: Pile foundations shall be designed and installed on the basis of a foundation investigation and report conducted in accordance with 780 CMR 1802.0. The investigation shall include borings, test pits or other subsurface explorations at locations and depths sufficient to determine the position, thickness and adequacy of the loadbearing soils and demonstrate that there are no compressible soil deposits below the bearing stratum which would adversely affect the structure, *except* where sufficient data upon which to base the design and installation are available from other sources. In addition, the building site shall be investigated for all conditions which might promote deterioration of pile foundations, in order to satisfy the requirements of 780 CMR 1816.4. The investigation and report shall include, but not be limited to, the following:

1. Recommended pile types and installed capacities;
2. Driving criteria;
3. Installation and field inspection procedures;
4. Pile load test requirements;
5. Durability of pile materials; and
6. Designation of loadbearing stratum or strata.

1816.2 Special piles: Types of piles not specifically covered by the provisions of 780 CMR 1816.0 may be permitted, subject to the approval of the code official, upon the submission of acceptable test data and design and construction information prepared by a *registered design professional* stating that the pile installation is adequate to fulfill the design requirements.

1816.3 Seismic Design

1816.3.1 Seismic reinforcement: Piles shall have minimum longitudinal reinforcement and confining reinforcement in accordance with the provisions for specific pile types set forth in 780 CMR 1818.0 through 780 CMR 1824.0.

Where a minimum length for reinforcement or the extent of closely spaced confinement reinforcement is specified at the top of the pile, provisions shall be made so that those specified lengths or extents are maintained after pile cutoff.

Where seismic reinforcement at the top of the pile is required, alternative measures for laterally confining concrete and maintaining toughness and ductile-like behavior at the top of the pile shall be permitted provided consideration is given to forcing the hinge to occur in the confined region.

1816.3.2 Pile bending seismic design: Piling for buildings assigned to *Seismic Performance Category D*, in accordance with 780 CMR 1612.2.7, shall be designed for the maximum imposed curvatures resulting from seismic forces on free-standing piles where the piles are located in loose granular soils or in soil-profile type S3 or S4, in accordance with 780 CMR 1612.4.1. The piles shall be designed and detailed in accordance with the special moment frame requirements of 780 CMR 1903.3.3 or 780 CMR 2203.2 for a length equal to 120% of the flexural length. The flexural length shall be the distance from the point of fixity to the pile cap.

1816.3.3 Pile cap seismic connection: Piles shall be connected to the pile caps in accordance with the provisions for specific pile types set forth in 780 CMR 1818.0 through 780 CMR 1824.0.

1816.3.4 Pile foundation seismic ties: Piles or pile caps shall be interconnected by ties capable of resisting, in tension or compression, a force equal to 10% of the larger column dead plus live load. Individual tie beams are not required when it is demonstrated that equivalent restraint will be provided by structural members within slabs on grade or reinforced concrete slabs on grade or confinement by competent rock, cohesive soils, dense granular soils or other approved means.

1816.4 Protection of pile materials: Where boring records, previous experience, or site conditions indicate possible deleterious action on pile materials because of soil constituents, changing water levels or other factors, the pile materials shall be adequately protected by approved materials, methods or processes. Protective materials shall be applied to the piles so as not to be rendered ineffective by driving.

1816.4.1 Steel and steel-concrete piles: At locations where steel and steel-concrete piles will be in contact with any material which is corrosive to the steel, one of the following procedures shall be used for protection, or any other method which will satisfy the requirements of the code official:

1. Remove all objectionable material.
2. Effectively protect the steel surface from pile cutoff grade to a grade 15 feet (4.6 m) below the bottom of the objectionable material by means of:
   a. cathodic protection as approved by the code official;
   b. an approved encasement of not less than three inches (76 mm) of dense concrete;
   c. an effective protective coating subject to the approval of the code official; or
   d. providing an excess steel thickness of ⅛ inch (3.2 mm) beyond design requirements on all exposed steel surfaces.

1816.4.2 Timber piles: The preservative treatment of timber piles shall comply with the provisions of 780 CMR 1822.2.

1816.5 Lateral support: Any soil shall be deemed to afford sufficient lateral support to permit the design of any type of pile as a short column. When piles are driven through soil which will be removed subsequent to the completion of the foundation, the resistance offered by such material shall not be considered to contribute to the lateral supporting capacity.

1816.5.1 Column action: The portion of a pile that is not laterally supported shall be designed as a column in accordance with 780 CMR 19 taking into consideration the conditions of end fixity.

1816.6 Group action: In cohesive soils, the compressive load capacity of a group of friction piles shall be analyzed by a generally accepted engineering method, and, where such analysis indicates, the individual allowable pile load shall be reduced accordingly.

1816.7 Stability:

1816.7.1 Wall foundations: All piles in wall foundations shall be staggered about the center of gravity of the wall load at a minimum distance of ½ the pile top diameter therefrom. A foundation wall restrained laterally so as to ensure stability both during and after construction may be supported by a single row of piles.

1816.7.2 Columns: Individual columns supported on piles shall be designed for eccentricity between the column and the centroid of the supporting piles equal to a minimum of three inches (76 mm) or the actual eccentricity, whichever is greater. The design shall account for such eccentricity through one of the following methods:

a. By supporting the column on a minimum of three piles in a triangular pattern.
b. By designing walls, grade beams or structural floors to resist the bending moment induced by the eccentricity.
c. By designing the piles, column or both to resist the bending moment induced by the eccentricity and providing adequate lateral restraint at the top of the piles to resist the lateral thrust due to the bending moment.

1816.8 Structural integrity: Piles shall be installed in such a manner and sequence as to prevent distortion or damage to piles being installed or already in place, to the extent that such distortion or damage affects the structural integrity of the piles.

When piles have been damaged in driving, or have been driven in locations and alignment other than those indicated on the plans, or have capacities less than required by the design, the affected pile groups and pile caps shall be investigated, and if necessary, the pile groups or pile caps shall be redesigned or additional piles shall be driven to replace the defective piles.

1816.9 Spacing: The minimum center-to-center spacing of piles shall be not less than twice the average diameter of a round pile, nor less than 1¾ times the diagonal dimension of a rectangular pile. When driven to or penetrating into rock, the spacing shall be not less than 24 inches (610 mm). When receiving principal support from end-bearing on materials other than rock or through frictional resistance, the spacing shall be not less than 30 inches (762 mm) or as provided in 780 CMR 1820.4.6 for Pressure Injected Footings.

1816.10 Splices: Splices shall be avoided insomuch as practicable. When used, slices shall be constructed so as to provide and maintain true alignment and position of the component parts of the pile during installation and subsequent thereto, and shall be of adequate strength to transmit the vertical and *lateral loads* and moments occurring at the location of the splice during driving and under service loading. Splices shall develop not less than 50% of the capacity of the pile in bending. Additionally, all pile splices occurring in the upper ten feet (3 m) of the embedded portion of the pile shall be capable of resisting at allowable working stresses the moment and shear that results from an assumed eccentricity of the pile load of three inches (76 mm); or the pile shall be braced in accordance with 780 CMR 1816.7 to other piles that do not have splices in the upper ten feet (3 m) of embedment.

1816.11 Pile caps: Pile caps shall be of reinforced concrete. The soil immediately below the pile cap shall not be considered as carrying any vertical load. The tops of all piles shall be embedded not less than three inches (76 mm) into pile caps, and the caps shall extend at least four inches (102 mm) beyond the edges of all piles. The tops of all piles shall be cut back to sound material before capping.

1816.12 Pre-excavation: Jetting, augering and other methods of pre-excavation must be approved by the code official and carried out in the same manner as used for piles subject to load test and in a manner which will not impair the carrying capacity of the piles already in place or the safety of existing adjacent structures. Pre-excavation shall be of the same method as carried out on piles subject to load tests. Immediately after completion of jetting or augering, the pile shall be advanced to the maximum depth of pre-excavation and driven below this depth to the required load resistance. Where load tests are required, pre-excavation of test piles will be of the same manner as proposed for production piles.

1816.13 Inspection: The owner shall engage a *registered design professional* who shall submit his qualifications in writing to the code official. This design professional, or his representative, who must be qualified by experience and training, shall be present at all times while piles are being driven to observe all work in connection with the piles. The design professional or his representative shall make an accurate record of the material and the principal dimensions of each pile, of the weight and fall of the ram, the type, size and make of hammer, cushion blocks, the number of blows per minute, the energy per blow, the number of blows per inch for the last six inches (150 mm) of driving, together with the grades at point and cutoff and any other pertinent details. A copy of these records shall be signed by the *registered design professional*, and filed in the office of the code official.

1816.14 Identification: All pile materials shall be identified for conformity to the specified grade with this identification maintained continuously from the point of manufacture to the point of installation or shall be tested by an *approved agency* to determine conformity to the specified grade and the *approved agency* shall furnish an affidavit of compliance to the code official .

1816.15 Pile location plan: A plan showing the location and designation of all piles by an identification system shall be filed with the code official prior to installation of such piles. All detailed records for individual piles shall bear an identification corresponding to that shown on the plan.

1816.16 Use of existing piles: Piles that have previously supported a partially or fully demolished structure shall not be used for support of new construction unless satisfactory evidence is submitted to the code official which indicates that the piles have not been adversely impacted by the demolition, are sound, have adequate capacity to support the new design loads, and meet all of the requirements of 780 CMR. The capacities of such piles shall be determined by analyses, load testing or redriving. The design load applied to such piles shall not exceed the greater of the following values:

a. actual sustained load determined to have been previously supported satisfactorily by the piles, up to a maximum of 120 tons

b. the documented, as-built design capacity of the piles, as confirmed by prior load testing

c. design capacity determined by analyses and confirmed by new load testing or by redriving per 780 CMR 1817.3.1 on one or more piles representative of each configuration (s) of pile and subsurface conditions.

1816.17 Pile driveability: Pile cross sections shall be of sufficient size and strength to withstand handling and driving stresses without damage to the pile and to provide sufficient stiffness to transmit the required driving forces. Driven piles of uniform cross section or tapered piles shall have a minimum nominal diameter of eight inches (200 mm) except as provided in 780 CMR 1820.6.4 for small diameter grouted piles, 780 CMR 1822.3.3 for timber piles and 780 CMR 1821.1 for precast concrete piles. Tapered shoes or points of lesser dimensions may be attached to the pile unit.

1816.18 Pile heave: Adequate provision shall be made to observe pile heave. Accurate reference points shall be established on each pile immediately after installation; for cast-in-place piles with unfilled corrugated shells, the reference point shall be at the bottom of the pile. If, following the installation of other piles in the vicinity, heaving of ½ inch (13 mm) or more occurs, the heaved piles shall be re-driven to develop the required capacity and penetration, or the capacity of the pile may be verified by load tests in accordance with 780 CMR 1817.4.

1816.19 Settlement analysis: The settlement of individual piles or groups of piles shall be estimated based upon approved methods of analysis and in accordance with 780 CMR 1805.2.2. The predicted settlement shall neither cause harmful distortion of or instability in the structure, nor cause any stresses to exceed allowable values.

1816.20 Use of vibratory drivers: Vibratory drivers shall only be used to install piles where the pile load capacity is verified by load tests in accordance with 780 CMR 1817.4. The installation of production piles shall be controlled according to power consumption, rate of penetration or other approved means that assure pile capacities equal to or exceeding those of the test piles.

1816.21 Installation sequence: Piles shall be installed in such sequence as to avoid compacting the surrounding soil to the extent that other piles cannot be installed properly, and to prevent ground movements that could damage adjacent structures.

780 CMR 1817.0 ALLOWABLE PILE LOADS

1817.1 General: The allowable load on piles shall be determined by the applicable formulas complying with accepted engineering practice or load tests as stated herein. The maximum load capacity shall be limited by the supporting capacity as obtained from bearing upon or embedment in bearing materials as defined in 780 CMR 1804.0 and 1805.0, but the load shall not exceed the capacity of the pile designed in accordance with the provisions of 780 CMR 1817.0 and the Code provisions for the construction materials involved.

The allowable load on a pile shall not be limited to load obtained by multiplying its point area by the allowable bearing pressure given in 780 CMR 1804.3.

1817.2 Piles in subsiding areas: Where piles are driven through subsiding fills or other subsiding strata and derive support from underlying firmer materials, the downward friction forces which are imposed on the piles by the subsiding upper strata shall be included in the design.

1817.3 Determination of allowable load: In the absence of pile load tests performed in accordance with 780 CMR 1817.4, the load on a single pile, except for the pile types covered in 780 CMR 1820.2 (augered uncased piles), 780 CMR 1820.4 (pressure injected footings) and 780 CMR 1824.0 (steel-core caissons), shall not exceed the higher of the two values determined in accordance with 780 CMR 1817.3.1 (driving formula) or 780 CMR 1817.3.2 (friction formula in clay). Loads on jacked piles shall be determined in accordance with 1817.3.3.

1817.3.1 Driving formula:

1. Where the design load capacity of the pile does not exceed 50 tons, the allowable load may be computed by means of the following driving formula:

$$R = \frac{2E}{S + C}$$

where--

R = allowable pile load in pounds;
E = energy per blow in foot-pounds;
S = penetration of last blow or average penetration of last few blows expressed in inches; and
C = constant equal to 1.0 for drop hammer and 0.1 for steam or air hammer.

2. When the design load capacity of a pile exceeds 50 tons, the required driving resistance shall be increased above that required by the driving formula in 780 CMR 1817.3.1 based on load tests or past experience under similar conditions.
3. The value of S must be determined with the hammer operating at 100% of the rated number of blows per minute for which the hammer is designed.
4. Any driving resistance developed in strata overlying the bearing material shall be discounted.
5. If the driving of the pile has been interrupted for more than one hour, the value of S shall not be determined until the pile is driven at least an additional 12 inches (305 mm), except when it encounters refusal on or is in a material of Classes 1 through 6.
6. When any pile is driven through a layer of gravel, sand or hard clay exceeding five feet in thickness, and through an underlying soft stratum to reach the bearing stratum, the bearing capacity shall not be determined in accordance with the driving formula, unless jetting is used during the entire driving of the pile through the layer of gravel, sand or hard clay or unless a hole is pre-excavated through said layer for each pile.

1817.3.2 Friction formula in clay: Where the design load does not exceed 22 tons, the allowable load on a pile stopped in soil of Material Class 10 (Table 1804.3) of medium to hard consistency may be based on a friction value of 500 psf of embedded pile surface. Higher design loads or other friction values shall be determined by pile load tests in accordance with 780 CMR 1817.4 or 1817.7.

The embedded length shall be the length of the pile below the surface of the Class 10 soil or below the surface of immediately overlying satisfactory bearing material. The area of embedded pile surface shall be computed by multiplying the embedded length by the perimeter of the smallest circle or polygon that can be circumscribed around the average section of the embedded length of the pile. The method of determining the allowable load described in 780 CMR 1817.3.2 shall not be used for a pile in which the drive pipe is withdrawn or for piles which are driven through the clay to or into firmer bearing materials.

In case these piles are in clusters, the allowable load shall be computed for the smaller of the following two areas: the sum of the embedded pile surfaces of individual piles; or the area obtained by multiplying the perimeter of the polygon circumscribing the cluster at the surface of the satisfactory bearing material by the average embedded length of the piles.

1817.3.3 Jacked piles:

1. Not less than 10% of jacked piles shall be load-tested to twice the design load (load test piles). All other jacked piles shall be founded in the same bearing stratum as the load test piles and shall be proof-loaded to 125% of design load (production piles).
2. For production piles, the 125% of design load shall be maintained for at least 30 minutes. Acceptability criteria: during final 15 minutes of load, the rate is not progressive (plot is linear or decreasing when settlement is plotted against logarithm of time); and the rate of settlement is equal to or less than that observed for load test piles during the corresponding time period under 125% of design load.
3. Settlement readings shall be plotted after one, two, four, eight, and 15 minutes, and at 15-minute intervals thereafter. Load shall be maintained on production piles until acceptability criteria are met.
4. For load test piles, the load shall be applied directly to 125% of design load and maintained for not less than 30 minutes, and until the settlement rate is not progressive (as defined above). Load shall then be increased to twice the design load and maintained constant for not less than four hours. Settlement during the four hour period shall not exceed 0.050 inches (1.3 mm).

   In the event that settlement exceeds 0.050 inches (1.3 mm) in four hours, the pile shall be deemed unacceptable for ½ of the final load. The allowable load on the rejected pile may be established by performing an additional load test at the lesser design load. The design load shall not exceed ½ the load maintained for a four hour period during which time settlement did not exceed 0.050 inches (1.3 mm).

1817.4 Compression load test: Where the design load for any pile is in doubt or where the proposed design load for any pile, including pressure injected footings, exceeds 50 tons or exceeds the value determined in accordance with 780 CMR 1817.3.2 (friction formula in clay), one or more pile load tests shall be performed on representative piles in accordance with 780 CMR 1817.0.

The results of the load test can be applied to other piles within the area of substantially similar subsoil conditions as that for the test pile, providing the performance of the test pile has been satisfactory and the remaining piles are of the same type, shape and size as the test pile and are installed using the same methods and equipment and are driven into the same bearing strata as the load-tested pile to an equal or greater penetration resistance.

For design loads between 50 and 120 tons, pile load tests may be waived by the code official, where justified, upon submittal of substantiating data prepared by a *registered design professional* which include experience and/or performance records for the proposed pile installation under similar soil and loading conditions.

1817.4.1 Required test load: A single pile shall be load-tested to not less than twice the allowable design load. When two or more piles are to be tested as a group, the total load shall be not less than 1½ times the allowable design load for the group.

In no case should the load reaching the top of the bearing stratum under maximum test load for a single pile or pile group be less than the following:

Case A-piles designed as end-bearing piles: 100% of the allowable design load.

Case B-piles designed as friction piles: 150% of the allowable design load.

For piles designed as combination end-bearing and friction piles, Case A applies if the pile is designed to support more than 50% of its design in bearing; otherwise, Case B applies.

1817.4.2 Internal instrumentation: The test pile shall be instrumented in accordance with the requirements in paragraph 4.4.1 of ASTM D1143 listed in ***Appendix A*** (hereinafter ASTM D1143) to enable measurement or computation of the load in the pile where it enters the bearing stratum. For piles containing concrete, instrumentation shall be installed in the test pile to permit direct measurement of the elastic modulus of the pile.

This requirement is waived for the following cases:

1. The test pile is installed within a casing that extends to within ten feet above the bearing stratum.
2. The pile to be tested has been functioning satisfactorily under load for a period of one year or more.
3. The pile is 30 feet long or less and no appreciable load will be supported above the bearing stratum.

1817.4.3 Loading procedure: Pile load tests shall be conducted in accordance with ASTM D1143, Standard Method of Testing Piles Under Static Axial Compressive Load, except that Section 5, Loading Procedures, shall be deleted and replaced by the following provisions:

1. Apply 25% of the allowable design load every ½ hour. Longer time increments may be used, but each time increment should be the same. In no case shall a load be changed in the rate of settlement is not decreasing with time.
2. At 200% of the allowable design load (or 150% for pile groups), maintain the load for a minimum of one hour and until the settlement (measured at the lowest point on the pile at which measurements are made) over a one-hour period is not greater than 0.01 in.
3. Remove 50% of the design load every 15 minutes until zero load is reached. Longer time increments may be used, but each should be the same.
4. Measure rebound at zero load for a minimum of one hour.
5. For each load increment or decrement, take readings at the top of the pile and on the internal instrumentation at one, two, four, eight and 15 minutes and at 15-minute intervals thereafter.

A load greater than 200% of the allowable design load (or 150% of the allowable design load for pile groups) may be applied at the top of the pile, using the above loading procedure, to ensure that 780 CMR 1817.4.1 is fulfilled. Other optional methods listed in ASTM D1143 may be approved by the code official upon submittal in advance of satisfactory justification prepared by a *registered design professional* who is qualified in this field.

1817.4.4 Selection of design load: Provided that the allowable design load does not exceed the load allowed in 780 CMR 1817.0 for the type of pile and provided that the allowable design load does not exceed 100% of the load supported in the bearing stratum (or ⅔ of the load supported in the bearing stratum for friction piles or pile groups) when the maximum test load is applied, then the allowable design load shall be the greater of the following:

1. Allowable design load based on settlement during loading: 50% of the applied test load which causes a gross settlement at the pile cutoff grade equal to the sum of: a) the theoretical elastic compression of the pile in inches assuming all the load on the butt is transmitted to the tip, plus b) 0.15 inch (3.8 mm), plus c) 1% of the pile tip diameter or pile width in inches. If the settlements are so small that the load-settlement curve does not intersect the failure criterion, the allowable design load shall be 50% of the maximum test load.
2. Allowable design load based on the net settlement after rebound: 50% of the applied test load which results in a net settlement at the top of the pile of ½ inch (13 mm) after rebound for a minimum of one hour at zero load.

1817.5 Use of higher allowable stresses: Higher stresses than those permitted in 780 CMR 1817 for various pile materials may be approved by the code official based upon the submission of substantiating data and analyses which justify such higher stresses. The data shall be presented in a report prepared by a *registered design professional* experienced in geotechnical aspects of foundation design and shall include, as applicable: the results of the soil investigation, dynamic analyses of the pile behavior, pile load tests, analyses of load transfer during testing and prediction of pile performance during long term service.

1817.6 Lateral load tests: The allowable load on piles subject to *lateral load* shall be verified by test unless it is waived by the code official. Pile load tests may be waived by the code official, where justified, upon submittal of substantiating data which include experience and/or performance records for pile installations under similar soil and loading conditions prepared by a *registered design professional* experienced in geotechnical aspects of foundation design.

1817.6.1 Required test load: A single pile shall be load tested to not less than 200% of the design *lateral load*.

1817.6.2 Test setup and loading procedure: The load test setup instrumentation and loading procedure shall be in accordance with ASTM D3966 listed in ***Appendix A***.

1817.6.3 Selection of design load: The design load shall be selected by the responsible *registered design professional*, based upon interpretation of the load-deflection data from the load test.

1817.7 Tension load tests: The allowable load on piles in tension shall be verified by test unless it is waived by the code official. Pile load test may be waived by the code official, where justified, upon submittal of substantiating data which includes experience and/or performance records for pile installations under similar soil and loading conditions prepared by a *registered design professional* experienced in the geotechnical aspects of foundation design.

1817.7.1 Required load test: A single pile or a pile group shall be load tested to not less than 200% of the design load for transient loads (i.e.: earthquake and wind) and 250% for sustained loads.

1817.7.2 Test setup and loading procedure: The load test setup, instrumentation and loading procedure shall be in accordance with ASTM D3689.

1817.7.3 Selection of design load: Provided the allowable design load does not exceed the allowable stresses in the pile materials, the allowable design load shall be the lower of the following:

1. 50% (for transient loads) or 40% (for sustained loads) of the applied test load which results in a net upward movement of ½ inch at the top of the pile after removal of the maximum test load (The gross upward movement minus the rebound movement).
2. 50% (for transient loads) or 40% (for sustained loads) of the applied test load which results in continuous upward movement with no increase in load.

1817.8 Bearing capacity: Individual piles and groups of piles shall develop ultimate load capacities of at least twice the design working loads in the designated bearing layers. Where weaker materials underlie the load bearing material into which the piles are driven, the allowable pile load shall be limited by the provision that the vertical pressures in such underlying materials produced by the loads on all piles in a foundation shall not exceed the allowable bearing pressures of such materials as provided in Table 1804.3 or as established by analysis, applying accepted principles of soil mechanics. Piles or pile groups shall be assumed to transfer their loads to the underlying materials by spreading the load uniformly at an angle of 60° with the horizontal, starting at a polygon circumscribing the piles at the top of the satisfactory bearing material in which they are embedded; but the area considered as supporting the load shall not extend beyond the intersection of the 60° planes of adjacent piles or pile groups.

1817.9 Bent piles: The load bearing capacity of piles discovered to have a sharp or sweeping bend shall be determined by an approved method of analysis or by load testing a representative pile.

1817.10 Overloads on piles: The maximum compressive load on any pile due to mislocation shall not exceed 110% of the allowable design load.

780 CMR 1818.0 STRUCTURAL STEEL PILES

1818.1 Materials: Structural steel piles and fully welded steel piles fabricated from plates shall conform to ASTM A36, A252, A283, A572 or A588 listed in *Appendix A*.

1818.2 Allowable stress: The allowable design compressive stress shall not exceed 35% of the minimum specified yield strength of the steel nor 12,600 psi. The maximum allowable design stress shall be limited to 50% of the minimum specified yield strength of the steel where higher stresses are substantiated by 780 CMR 1817.5.

1818.3 Pile cap seismic connection: All structural steel piles shall be connected to the pile cap with a connection detail designed for a minimum tensile force equal to 10% of the pile compression design *load.*

1818.4 Dimensions of H-piles: Sections of H-piles shall comply with the criteria of 780 CMR 1818.4.1 through 1818.4.4.

1818.4.1 Flanges: The flange projections shall not exceed 14 times the minimum thickness of metal in either the flange or the web, and the flange widths shall not be less than 80% of the depth of the section.

1818.4.2 Depth: The nominal depth in the direction of the web shall not be less than eight inches.

1818.4.3 Thickness: Flanges and webs shall have a minimum nominal thickness of ⅜ inch (9.5 mm).

1818.4.4 Tip reinforcement: The tips of all steel H piles having a thickness of metal less than 5/10 inches (12.7 mm) which are driven to end bearing on rock of Classes 1 through 3 by an impact hammer shall be reinforced. The installation of all steel H piles by impact hammer to end bearing on rock of Classes 1 through 3 shall be conducted so as to terminate driving when the pile reaches refusal on the rock surface.

780 CMR 1819.0 CONCRETE-FILLED STEEL PIPE AND TUBE PILES

1819.1 Material: Steel pipe and tube piles shall conform to ASTM A252 or A283 listed in Appendix A. Concrete shall conform to 780 CMR 1820.1.1.

1819.2 Allowable stress:

1819.2.1 Top driven piles: The allowable design compressive stress in the concrete shall not exceed 25% of the 28-day compressive strength of the concrete or 1,100 pounds per square inch whichever is smaller. The maximum allowable compressive stress in the steel shall not exceed 9,000psi.

1819.2.2 Mandrel driven piles: For piles installed with mandrels which transmit driving stresses to the bottom of the steel pipe, the allowable design compressive stress in the concrete shall not exceed 33% of the 28-day specified compressive strength. The allowable design compressive stress in the steel shall not exceed 35% of the minimum specified yield strength of the steel. The maximum allowable design stress shall be limited to 50% of the minimum specified yield strength of the steel where higher stresses are substantiated by 780 CMR 1817.

1819.3 Reinforcement: Except for steel dowels embedded five feet (1.5m) or less in the pile and as provided for in 780 CMR 1802.2 and 1802.6, reinforcement, where required, shall be assembled and tied together and shall be placed in the pile as a unit before the reinforced portion of the pile is filled with concrete.

1819.3.1 Seismic reinforcement: All pipe piles shall have over their full length a minimum area of steel, after allowance for corrosion, of 0.25 percent of the pile cross-sectional area for buildings assigned to *Seismic Performance Category C,* and a minimum area of steel of 0.50 percent for buildings assigned to *Seismic Performance Category D,* in accordance with 780 CMR 1612.2.7.

1819.3.2 Pile cap seismic connection: All concrete-filled steel pipe and tube piles shall be connected to the pile cap by providing longitudinal reinforcement at the top of the pile equal to 1 % of the pile cross-sectional area. The reinforcement shall extend into the pile for a length equal to two times the required embedment anchorage into the pile cap. The embedment in the pile cap shall equal the development length as specified in ACI 318 as listed in Appendix A. The development length to be provided in the cap is the full development length for compression without reduction in length for excess area. Field-placed dowels anchored in the concrete are acceptable.

NON-TEXT PAGE

1819.4 Minimum dimensions: Piles shall have a nominal outside diameter of not less than eight inches (203 mm) and a minimum wall thickness of 1/10 inch (2.5 mm), except that for piles driven open ended, the nominal outside diameter shall not be less than ten inches (254 mm) and the wall thickness not less than ¼ inch (6.4 mm) for diameters less than 14 inches (356 mm) and ⅜ inch (9.5 mm) for diameters greater than 14 inches. Pipe of lesser wall thickness may be used if a suitable cast steel cutting shoe is provided.

1819.5 Placing concrete: The placement of concrete shall conform to 780 CMR 1820.1.3 and 1820.5.

780 CMR 1820.0 CAST-IN-PLACE CONCRETE PILES

1820.1 General: 780 CMR 1820.0 includes augered uncased piles, pressure injected footings (enlarged base piles), cased poured piles, and small diameter grouted piles. Unless otherwise noted, the materials, reinforcing and installation shall conform to 780 CMR 1820.1.1 through 1820.1.3.

1820.1.1 Material: All concrete shall have a 28-day specified compressive strength (f'_c) of not less than 3,000 psi (2.11 kg/mm^2). The maximum size of coarse aggregate for all concrete shall be ¾ inch (19 mm), and the concrete shall have a slump of four to seven inches (102 mm to 178 mm). If concrete is to be pumped, the mix design including slump shall be adjusted to produce a pumpable concrete.

1820.1.2 Reinforcement: Except for steel dowels embedded five feet (1.5 m) or less in the pile and as provided for in 780 CMR 1820.2 and 1820.6, reinforcement, where required, shall be assembled and tied together and shall be placed in the pile as a unit before the reinforced portion of the pile is filled with concrete.

1820.1.2.1 Seismic reinforcement: All cast-in-place concrete piles shall have minimum reinforcement of 0.25% of the pile cross-sectional area for buildings assigned to *Seismic Performance Category C*, and a minimum reinforcement of 0.50% for buildings assigned to *Seismic Performance Category D* in accordance with 780 CMR 1612.2.7. The reinforcing shall be placed in the top ⅓ of the pile length or extend ten feet (3 m) from the top of the pile, whichever is the longer length.

For *Seismic Performance Category C* buildings, the pile reinforcing shall be a minimum of four longitudinal bars with closed ties, or equivalent spirals, having a minimum diameter of ¼ inch. The ties shall be provided at a maximum spacing of 16 times the longitudinal reinforcing bar diameter. The maximum tie spacing in the top two feet (610 mm) of the pile length shall be four inches (102 mm). Tie detailing shall be in accordance with 780 CMR 1903.4

For *Seismic Performance Category D* buildings, the pile reinforcing shall be minimum of four longitudinal bars with closed ties, or equivalent spirals, having a minimum diameter of ⅜ inch, for piles with a diameter of 20 inches (205 mm) or less; and a minimum tie diameter of ½ inch, for piles with a diameter more than 20 inches (508 mm). The ties shall be provided at a minimum spacing of eight times the longitudinal reinforcing bar diameter. The maximum tie spacing in the top four feet (1.2 m) of the pile length shall be three inches (76 mm)

> **Exception**: Pile ties or spirals are not required where permanent metal casing (steel pipe, steel tube or spiral-welded steel shell) is used, provided the casing has minimum thickness as follows: for *Seismic Performance Category C* buildings, 0.058 inch (1.5 mm), and for *Seismic Performance Category D* buildings, 0.070 inch (1.8mm). The steel casing must be adequately protected from corrosion due to soil, changing water levels or other subgrade conditions indicated by the site soil investigation.

1820.1.2.2 Pile cap seismic connection: All cast-in-place concrete piles shall be connected to the pile cap by extending the pile reinforcing into the pile cap for a distance equal to the development length as specified in ACI 318 listed in Appendix A. The development length to be provided in the cap is the full development length for compression without reduction in length for excess area. Field-placed dowels anchored at least twice the required cap development length are acceptable.

1820.1.3 Installation: For all cased piles, the inside of the pipe or casing shall be thoroughly cleaned to the bottom and visually inspected prior to filling with concrete. The piles shall be poured in such a manner as to exclude all foreign matter and to assure a well-formed unit of full cross-section. The concreting shall be subject to the following limitations.

1. The diameter shall not vary more than 20% from the specified value.
2. Concrete shall not be placed through water except where tremie methods are approved.
3. When depositing concrete from the top of the pile, the concrete flow shall be rapid and continuous, and centered at the top of the pile.

4. After filling with concrete, the top ten feet (3 m) shall be thoroughly rodded.
5. No pile shall be installed within a distance of nine feet (2.7 m) from a pile which has been filled with concrete for less than 12 hours, unless approved.

1820.2 Augered uncased piles:

1820.2.1 Definition: An augered uncased pile is defined as a structural member installed utilizing a hollow-stem auger no less than 12 inches (305 mm) in outside diameter which extends to satisfactory bearing materials to develop support by end bearing and/or friction in those materials.

1820.2.2 Pile diameter: The design pile diameter shall be taken as the outside diameter of the hollow stem auger.

1820.2.3 Allowable design stresses: Except as provided in 780 CMR 1817.5, the design stresses shall not exceed the following values:

1. For compression loads: The maximum allowable design stress on the cement grout or concrete shall be 33% of the specified 28- day unconfined compressive strength, but not exceeding 1,600 psi. The maximum allowable design stress on the steel reinforcing, including permanent steel casing, shall be 40% of the minimum specified yield strength, but not exceeding 24,000 psi.
2. For tension loads: The maximum allowable design tensile stress on the steel reinforcing shall be 60% of the minimum specified yield strength. The allowable design tensile stress on the cement grout shall be zero.

1820.2.4 Reinforcement: Reinforcement shall be as required in 780 CMR 1820.1., except reinforcement may be placed after withdrawal of the auger where approved by the code official.

1820.2.4.1 Concrete cover: The minimum concrete cover shall be 2½ inches (64 mm) for uncased shafts and one inch (25 mm) for cased shafts.

1820.2.4.2 Corrosion protection: Corrosion protection shall be as detailed in 780 CMR 1820.6.6.

1820.2.5 Minimum spacing: The minimum center-to-center spacing between adjacent piles shall not be less than 30 inches (760 mm) or two times the pile diameter, whichever is greater. In addition, for groups of friction piles, the overall circumference of a pile group shall exceed the sum of the circumferences of all of the individual piles within the group.

1820.2.6 Installation: Augered uncased piles shall be formed by advancing a closed-end continuous-flight hollow-stem auger of uniform diameter through unsuitable material and into a satisfactory bearing material followed by removal of the tip closure and pumping cement grout or concrete through the hollow-stem while the hollow-stem auger is extracted. During advancement, the hollow-stem auger shall be rotated rapidly such that the material through which the auger is being advanced is removed by the auger flights and is not displaced laterally by the auger. During withdrawal, if the hollow stem auger is rotated, it shall be rotated in a positive (advancing) direction.

1. The grout or concrete shall be pumped under continuous pressure and in one continuous operation. Grout or concrete pump pressures shall be measured and maintained at all times sufficiently high to offset hydrostatic and lateral earth pressures. The rate of withdrawal of the auger shall be carefully controlled to exclude all foreign matter and ensure that the augered hole is completely filled with grout or concrete as the auger is withdrawn. The actual volume of grout or concrete pumped into each hole shall be equal to, or greater than , the theoretical volume of the augered hole.
2. If the grouting or concreting process of any pile is interrupted, or a loss of concreting pressure occurs, the pile shall be redrilled to its original depth plus six inches (152 mm) (unless bearing on rock) and filled from the bottom.
3.. Augered uncased piles shall not be installed within six pile diameters (center-to-center) of a pile filled with grout or concrete less than 24-hours old except where approved by the code official.

1820.2.7 Records: The owner shall engage a *registered design professional* to monitor the installation of augered uncased piles in accordance with 780 CMR 1816.13. The design professional or his representative shall make an accurate record of the installation equipment used, pile dimensions, grout or concrete volumes, reinforcement, interruptions or delays in pile installation, and all other pertinent installation data.

1820.2.8 Instrumentation: The continuous-flight auger rig utilized to install augered uncased piles shall be equipped with data logging equipment that automatically monitors and produces a real-time printout of depth, grout or concrete pressure, grout or concrete flow, and rate of auger withdrawal. The automatic monitoring equipment shall immediately indicate to the equipment operator, and record on the printed record, any instance during the withdrawal of the hollow-stem auger where the rate of auger withdrawal times the theoretical pile cross-sectional area exceeds the rate of grout or concrete placement. A printed instrumentation readout for each pile shall be provided to the design professional's representative upon completion of each pile.

1820.3 Driven uncased pile: No provisions.

1820.4 Pressure-injected footings: **(Enlarged base piles)**

1820.4.1 Materials: Concrete shall satisfy the provisions of 780 CMR 1820.1.1. Compacted concrete shall have a zero slump. Reinforcement shall be as provided in 780 CMR 1820.1.2.

1820.4.2 Allowable design stresses: The maximum allowable design stress on shaft concrete shall be 33% of the 28-day strength, but not exceeding 1,600 psi. The maximum allowable design stress on permanent steel casing, if at least 1/10-inch (2.5 mm) thick, and on steel reinforcing shall be 40% of the minimum specified yield strength, but not exceeding 24,000 psi.

1820.4.3 Installation: The installation of pressure-injected footings shall fulfill the following requirements:

1820.4.3.1 Base:

1. The enlarged base of a pressure-injected footing shall be formed on or in bearing materials of Classes 1 to 9 inclusive. The Class 9 material (fine sand) shall have a maximum of 15% by weight finer than the No. 200 mesh sieve and shall be non-plastic, unless satisfactory load test results or other substantiating data are submitted to, and approved by, the code official.
2. The compacted concrete placement shall be in measured batches, to establish impact energy required per unit volume of concrete. A minimum of one Standard Batch Volume of concrete, as defined in Table 1820.4, shall be injected in the base, after expulsion of the concrete plug or boot used to close the tube during the driving process.

1820.4.3.2 Shaft installation:

1820.4.3.2.1 Uncased compacted-concrete shaft:

1. Concrete shall be placed at zero slump, in small batches, and shall be compacted in place in a controlled manner as the drive-tube is withdrawn.
2. Pressure injected footings formed through soils of Classes 10 and 11, located less than nine feet or within the heave range from an uncased shaft, shall be pre-drilled through such soil.
3. An uncased compacted-concrete shaft shall not be formed through very soft to soft soils of Classes 10 and 11. The code official may waive this requirement based upon satisfactory evidence prepared by a *registered design professional* that the soil has sufficient strength for proper shaft construction.
4. A suitable method shall be employed by the contractor and the design professional to verify and record that the entire length of the shaft is completely filled with concrete. Such means shall include the ability to determine the incremental volume of concrete installed in relation to the calculated shaft volume.

1820.4.3.2.2Uncased high-slump concrete shaft:

1. Concrete shall be placed at not less than eight-inch slump, except that slump as low as four inches may be allowed if adequate vibration is applied to the drive-tube during the entire withdrawal process. During withdrawal, the level of concrete within the tube shall have a positive differential head over external soil and water pressures at all times.
2. The shaft shall be provided with full-length reinforcing steel anchored in the enlarged base. At a minimum, provide a cage with four, full length, number five reinforcing bars evenly spaced near the shaft perimeter.
3. Pressure injected footings located less than nine feet (2.7 m) from a completed uncased high-slump shaft shall not be installed until at least 12 hours after shaft pour.
4. A suitable method shall be employed by the contractor and the design professional to verify and record that the entire length of the shaft is completely filled with concrete. Such means shall include the ability to determine the incremental volume of concrete installed in relation to the calculated shaft volume.

1820.4.3.2.3 Cased shaft:

1. The permanent metal casing shall be fastened to the enlarged base in such a manner that the two will not separate.
2. Concrete shall be placed in the same manner as for cased poured concrete piles. The requirements of 780 CMR 1820.1.3 shall apply.

1820.4.4 Loadbearing capacity:

1. Pile loadbearing capacity shall be verified by load tests as required in 780 CMR 1817.4.
2. For loads up to 120 tons, the allowable load may be computed by the following formula:

$$R = \frac{B \times E}{C} V^{2/3}$$

Where:

R = allowable load in pounds;

B =average number of blows required to inject one cubic foot of concrete, during injection of the last batch;
E =Energy per blow in foot-pounds;
C =constant; and
V =total volume of base concrete in cubic feet.

The values of R, E, and C shall conform to Table 1820.4 unless other values are determined by load test, in which case the latter values shall control. Use of Table 1820.4 is limited by the provisions of 780 CMR 1817.4.

The value of V shall include an allowance of one Standard Batch Volume of concrete, if concrete is used in the tube during the driving process, plus the additional volume of concrete injected during formation of the base.

3. During injection of the last batch of concrete in the base, the height of concrete within the drive tube shall not be more than ⅓ of the drive-tube inside diameter.

TABLE 1820.4

R (tons)	Energy, E (foot-pounds)	C	Standard Batch Volume (cubic feet)
over 100	140,000	18	5
51 to 100	100,000	18	5
25 to 50	60,000	30	2

1820.4.5 Loading: The load on pressure-injected footings shall be limited by the provisions of 780 CMR 1817.8 except that the circumscribing polygon shall start at the junction of the shaft and the enlarged base, and the bearing area shall be taken at planes six feet or more below the junction, or at the top of weaker material, whichever is higher.

1820.4.6 Spacing: The center-to-center spacing of pressure-injected footings with uncased shafts shall be not less than 2½ times the outside diameter of the drive tube and not less than 3½ feet. The center-to-center spacing of pressure-injected footings with cased shafts shall be not less than three times the shaft diameter.

1820.5 Cased poured concrete piles: Steel-cased piles shall comply with the requirements of 780 CMR 1820.5.1 through 1820.5.4.

1820.5.1 Materials: Concrete shall satisfy the provisions of 780 CMR 1820.1.1. Pile shells or casings shall be of steel and shall be sufficiently strong to resist collapse and sufficiently water tight to exclude any foreign materials during the placing of concrete. The shape of the pile may be cylindrical, or conical, or a combination thereof, or it may be a succession of cylinders of equal length, with the change in diameter of adjoining cylinders not exceeding one inch.

1820.5.2 Allowable design stresses: The load on cased poured concrete piles shall be as provided in 780 CMR 1817.0 and shall not exceed the load computed on the basis of 33% of the 28-day strength of the concrete, nor 1,600 psi when applied to the cross-sectional area computed on the following basis:

1. For metal-cased piles driven to and into materials of Classes 1 to 4 inclusive, using the diameter measured one foot (0.3 m) above the point, except that when the rock is immediately overlain by a bearing stratum consisting of one or a combination of bearing materials of Classes 5, 6, and 7, using the diameter at the surface of the bearing stratum.
2. For metal-cased piles, driven through compressible materials including Classes 10 and 11 and into a bearing stratum consisting of one or a combination of bearing materials of Classes 5-9 inclusive, using the diameter at the surface of the bearing stratum.

1820.5.3 Installation: Piles shall have steel shells or casings which are mandrel-driven their full length in contact with the surrounding soil, left permanently in place and filled with concrete. The requirements of 780 CMR 1820.1.3 shall apply.

1820.6 Small diameter grouted piles:

1820.6.1 General: 780 CMR 1820.6 covers grouted cast-in-place piles which are less than 12 inches (305 mm) in diameter and in which all or a portion of the pile is cast directly against the soil without permanent casing.

1820.6.2 Materials: Concrete or sand-cement grout shall satisfy the provisions of 780 CMR 1820.1.1.

1820.6.3 Allowable load: The load on small diameter grouted piles shall not exceed the allowable load computed on the basis of the allowable stresses given in 780 CMR 1820.2.3 and the requirements of 780 CMR 1820.6.3.1 and 1820.6.3.2.

1820.6.3.1 Minimum reinforcing: The steel reinforcing shall be designed to carry the following minimum percentage of the design compression load:

1. For a pile or a portion of a pile grouted inside a temporary casing, grouted inside a hole drilled into rock, or grouted with a hollow-stem auger, the reinforcing steel shall be designed to carry not less than 40% of the design compression load.
2. For a pile or a portion of a pile grouted in an open drill hole without temporary or permanent casing or grouted within materials of Classes 1 through 5, the pile shall be designed to carry the entire design

compression load on the reinforcing steel. If a steel pipe section is used for reinforcing, any portion of the cement grout enclosed within the pipe may also be included at the allowable stress for the grout.

1820.6.3.2 Load test: For all design loads, the allowable load shall be determined by load tests in accordance with 780 CMR 1817.4. Load tests may be waived by the code official based on substantiating data and analyses prepared by a *registered design professional*.

1820.6.3.3 Alternative load test procedure for friction piles: For piles designed as friction piles, the friction capacity in compression may be verified by load testing in tension. The tension load test shall be performed in accordance with 780 CMR 1817.7, with the following exceptions:

1. The test pile must be cased or left ungrouted down to the top of the bearing stratum in a manner which will ensure that no friction resistance is developed above the bearing stratum.
2. The maximum design load shall be taken as 50% of the applied test load which results in a movement under load of ½ inch (13 mm) at the pile tip. The movement at the pile tip shall be a.) measured directly by a tell-tale or b.) computed by deducting the theoretical elastic elongation of the pile from the displacement measured at the top of the pile.

1820.6.4 Installation: The pile may be formed in a hole advanced by rotary or rotary percussive drilling methods (with or without temporary casing), by a hollow-stem auger, or by driving a temporary casing. The pile shall be grouted with a fluid cement grout. The grout shall be pumped through a tremie pipe extending to the bottom of the pile until grout of suitable quality returns at the top of the pile.

The following requirements apply to specific installation methods:

1. Piles grouted with temporary casing: For piles grouted inside a temporary casing, the reinforcing steel shall be inserted prior to withdrawal of the casing. The casing shall be withdrawn in a controlled manner with the grout level maintained at the top of the pile, to ensure that the grout completely fills the drill hole. During withdrawal of the casing, the grout level inside the casing shall be monitored to check that the flow of grout inside the casing is not obstructed.
2. Piles grouted without temporary casing: For a pile or portion of a pile grouted in an open drill hole in soil without temporary casing, the minimum design diameter of the drill hole shall be verified by a suitable device immediately prior to grouting. The reinforcing steel shall be inserted prior to grouting.
3. Piles grouted with hollow-stem augers: For piles installed with a hollow-stem auger, the grout shall be pumped under continuous pressure, and the rate of withdrawal of the auger shall be carefully controlled to ensure that the hole is completely filled with grout as the auger is withdrawn. The actual volume of grout pumped for each one foot (0.3 m) of withdrawal of the auger shall be recorded and must be equal to or greater than the theoretical volume. The reinforcing steel shall be inserted prior to withdrawal of the auger.
4. For piles designed for end bearing, a suitable means shall be employed to verify that the bearing surface is properly cleaned prior to grouting.
5. Subsequent piles shall not be drilled or driven near piles that have been grouted until the grout has had sufficient time to harden.

1820.6.5 Pile diameter: The design pile diameter shall be taken as:

1. The outside diameter of the temporary casing; or
2. The diameter of a full circumferential drill bit attached to the bottom of the temporary casing; or
3. The outside diameter of the hollow-stem auger; or
4. The borehole diameter verified by suitable measurements made immediately prior to grouting.

1820.6.6 Corrosion protection:

1. Minimum grout cover: Where steel reinforcing is not enclosed inside a permanent casing, centralizers shall be provided on the reinforcing to ensure a minimum grout cover of one inch (25 mm) in soil and ½ inch (13 mm) in rock. Grout cover requirements may be reduced when the reinforcing steel is provided with a suitable protective coating.
2. Permanent steel casing that is used as structural reinforcing shall be protected in accordance with the provisions of 780 CMR 1816.4.2.
3. For piles subjected to sustained tension loading in corrosive environments, the reinforcing steel shall be protected by a suitable protective coating or encapsulation method.

1820.6.7 Records: The owner shall engage a *registered design professional* to observe the installation of the piles in accordance with 780 CMR 1816.13. The design professional or his representative shall make an accurate record of the installation equipment used, pile dimensions, grouting volumes and procedures used and all other pertinent installation data.

780 CMR 1821.0 PRECAST CONCRETE PILES

1821.1 Design and manufacture: All piles shall be designed and manufactured in accordance with accepted engineering practice to resist all stresses induced by handling, driving and service loads. The minimum lateral dimension shall be ten inches (254 mm). All corners of square piles shall be chamfered. Longitudinal steel shall be arranged in a symmetrical pattern and shall be laterally tied with steel ties or wire spiral spaced not more than three inches (76 mm) apart, center to center, for a distance of two feet (610 mm) from the ends of the pile; and not more than six inches (152 mm) elsewhere except that at the ends of each pile, the first five ties or spirals shall be spaced one inch (25 mm) center to center. When driven to or into bearing materials of Classes 1 to 6 inclusive, or through materials containing boulders, piles shall have metal tips of approved design.

1821.1.1 Installation: All piles shall be handled and driven so as not to cause injury or overstressing which affects durability or strength.

1821.2 Reinforced piles: Reinforced precast concrete piles shall conform to 780 CMR 1821.2.1 through 1821.2.5.

1821.2.1 Design: The minimum amount of longitudinal reinforcement shall be 2% of the concrete section and shall consist of at least four bars.

1821.2.2 Material: All concrete shall have a 28-day specified compressive strength (f'_c) of not less than 4,000 psi (2.81 kg/mm^2).

1821.2.3 Allowable stress: The allowable compressive stress in the concrete shall not exceed 33% of the 28-day specified compressive strength (f'_c) nor 1,600 psi applied to the gross cross-sectional area of the pile.

1821.2.4 Concrete cover: All pile reinforcement shall have a concrete cover of not less than two inches (51 mm), except that piles exposed to sea water shall have a minimum protective concrete cover of three inches (76 mm).

1821.2.5 Installation: A precast concrete pile shall not be driven before the concrete has attained a compressive strength of at least 3,000 psi (2.11 kg/mm^2), but not less than such strength sufficient to withstand handling and driving forces.

1821.2.6 Pile cap seismic connection: Precast concrete piles shall be connected to the pile cap in accordance with the requirements of 780 CMR 1820.1.2.2.

1821.3 Prestressed piles: Prestressed concrete piles shall conform to the requirements of 780 CMR 1821.3.1 through 1821.3.6.

1821.3.1 Design: The effective prestress in the pile shall not be less than 700 psi (0.49 kg/mm^2).

1821.3.2 Material: Prestressing steel shall conform to ASTM A416 listed in ***Appendix A***. All concrete shall have a 28-day specified compressive strength (f'_c) of not less than 5,000 psi (3.52 kg/mm^2).

1821.3.3 Allowable stress: The maximum allowable design compressive stress (f_c) in concrete shall be determined as follows:

$$f_c = 0.33\, f'_c - 0.27\, f_{pc}$$

where f'_c is the 28-day compressive strength and f_{pc} is the effective prestress on the gross area of the pile section; however, 0.33 f'_c shall not exceed 1,600 psi.

1821.3.4 Installation: A prestressed pile shall not be driven before the concrete has attained a compressive strength of at least 4,000 psi (2.81 kg/mm2), but not less than such strength sufficient to withstand handling and driving forces.

1821.3.5 Pile cap seismic connection: Prestressed concrete piles shall be connected to the pile cap in accordance with the requirements of 780 CMR 1820.1.2.2 or by extension of the pile reinforcing strand into the pile cap. The embedment of reinforcing into the pile cap shall develop the strength of the reinforcing strand. Prestressed pile cap connections in buildings assigned to *Seismic Performance Category D*, in accordance with 780 CMR 1612.2.7, shall not be by development of exposed strand.

1821.3.6 Spiral seismic reinforcing: The upper two feet of the pile immediately below the pile cap shall have No. 3 ties minimum at not over four-inch spacing, or equivalent spirals. The spiral reinforcement in prestressed piles for buildings assigned to *Seismic Performance Category D*, in accordance with 780 CMR 1612.2.7, shall not be less than 0.6% for the full length of the pile where subjected to vertical *loads* only or where the design bending moment does not exceed 20% of the unfactored ultimate moment capacity at balanced strain conditions computed in accordance with ACI 318 listed in ***Appendix A***.

780 CMR 1822.0 TIMBER PILES

1822.1 Materials: Round timber piles shall conform to ASTM D25 listed in ***Appendix A***. Round timber piling shall be new longleaf, shortleaf, loblolly or slash species of Southern pine, oak, Douglas fir or other woods of similar strength and physical characteristics.

1822.2 Preservative treatment: Timber piles used to support permanent structures shall be pressure treated in accordance with AWPA C3 listed in ***Appendix A*** for round timber piles. Preservative-treated timber piles shall be subject to a quality control program administered by an approved agency. Pile cutoffs shall be treated in accordance with AWPA M4 listed in ***Appendix A***.

1822.3 Allowable load:

1822.3.1 Allowable stress: The allowable stress in the timber shall not exceed 1,000 psi in compression at the critical cross-sectional area taken at the top of the bearing stratum. Piles designed for end bearing on materials of Classes 1 through 5 shall be designed for a maximum stress of 500 psi in compression on the pile cross-sectional area at the tip.

1822.3.2 Maximum Load: The load on timber piles shall not exceed the allowable load specified in 780 CMR 1817.0 nor 35 tons, whichever is smaller.

1822.3.3 Minimum dimensions: Timber piles shall be sized to conform to the minimum tip sizes as specified in ASTM D25 but no less than six inches (152 mm) in diameter at the tip.

1822.4 Precautions during driving:

1822.4.1 Hammer energy: Pile hammer energy shall be selected to prevent damage to the pile, but in no case shall the maximum hammer energy, as rated by the manufacturer, exceed 18,000 ft. lbs. For end bearing piles, on materials of Class 1 through 5, the maximum hammer energy shall be reduced.

1822.4.2 Driving resistance: Driving shall be stopped immediately when abrupt high resistance to penetration is encountered. Any sudden decrease in driving resistance of an end-supported timber pile shall be investigated with regard to the possibility of damage. If the sudden decrease in driving resistance cannot be correlated to loadbearing data, the pile shall be removed for inspection or rejected.

780 CMR 1823.0 COMPOSITE PILES

1823.1 Design: Composite piles consisting of two or more approved pile types shall be designed to meet the conditions of installation.

1823.2 Limitation of load: The maximum allowable load shall be limited by the capacity of the weakest section incorporated in the pile.

1823.3 Splices: Splices between concrete and steel or wood sections shall be designed to prevent separation both before and after the concrete portion has set, and to insure the alignment and transmission of the total pile load. Splices shall be designed to resist uplift caused by upheaval during driving of adjacent piles, and shall develop the full compressive strength and not less than 50% of the tension and bending strength of the weaker section.

780 CMR 1824.0 CONCRETE-FILLED PIPE WITH STEEL CORE CAISSONS

1824.1 Construction: These units shall consist of a shaft section of concrete-filled pipe extended to and firmly seated in bedrock of Classes 1 or 2 with an uncased socket drilled into the bedrock which is filled with cement grout. A steel core shall be centered in the shaft and shall extend through the cement grout to the bottom of the socket.

1824.2 Rock socket: A socket, approximately the inside diameter of the pipe, shall be made in bedrock of Classes 1 or 2 to a depth that will assure load transfer when computed for bearing on the bottom surface of the socket in accordance with 780 CMR 1803.0, 1807.0 and 1817.0 acting together with a bond stress on the perimeter surface of the socket. The socket design stress shall be determined by a *registered design professsional* based upon foundation investigation study in accordance with 780 CMR 1816, but in no case will the design bond stress on the perimeter of the socket exceed 200 psi. Load tests, in accordance with 780 CMR 1817.4, may be required by the code official if foundation investigation data are judged insufficient to verify the selected bond stress. The minimum socket depth shall be at least equal to the diameter of the pipe. Before placement of concrete, the socket and pipe shall be thoroughly cleaned and the rock inspected by a *registered design professional* or his qualified representative.

1824.3 Seismic design: All caisson piles shall meet the seismic design requirements of 780 CMR 1819.3.

1824.4 Material: Pipe and steel cores shall conform to the material requirements in 780 CMR 1818.0. Pipe shall have a minimum diameter of 18inches (457 mm) and a minimum wall thickness of ⅜ inch (9.5 mm) and shall be fitted with a suitable steel driving shoe welded to the bottom of the pipe. All concrete shall have a 28-day specified compressive strength (f'_c) of not less than 4,000 psi (2.81 kg/mm^2). The concrete mix shall be designed and proportioned so as to produce a cohesive workable mix with a slump of four inches (102 mm) to six inches (152 mm).

1824.5 Structural core: The gross cross-sectional area of the structural steel core shall not exceed 25% of the gross area of the caisson. The minimum clearance between the structural core and the pipe shall be two inches (51 mm). If cores are to be spliced, the ends shall be milled or ground to provide full contact and shall be full-depth welded.

1824.6 Allowable stress: The allowable design compressive stresses shall not exceed the following: concrete, 0.33 f'_c; steel pipe, 0.35 f_y; and structural steel core, 0.50 f_y.

1824.7 Installation: The rock socket and pile shall be thoroughly cleaned of all foreign materials before filling with cement grout and concrete. Steel cores shall be bedded in cement grout at the base of the rock socket.

1824.8 Spacing: The minimum center-to-center spacing shall be not less than 2½ times the outside diameter of the steel shell.

780 CMR 1825.0 RETAINING WALLS

1825.1 General: Walls built to retain or support the lateral pressure of earth or water or other superimposed loads shall be designed and constructed of approved masonry, reinforced concrete, steel sheet piling or other approved materials within the allowable stresses specified in 780 CMR 2311.7.

1825.2 Design: Retaining walls shall be designed to resist the pressure of the retained material, including both *dead* and *live load* surcharges to which such walls are subjected, and to insure stability against overturning, sliding, excessive foundation pressure and water uplift. Retaining walls shall be designed to resist seismic loads in accordance with 780 CMR 1612.4.9.

1825.3 Hydrostatic pressure: Unless drainage is provided, the hydrostatic head of the water pressure shall be assumed to be equal to the height of the wall.

1825.4 Coping: All masonry retaining walls, other than reinforced concrete walls, shall be protected with an approved coping.

1825.5 Guards: Where retaining walls with differences in grade level on either side of the wall in excess of four feet (1.2 m) are located closer than two feet (0.6 m) to a walk, path, parking lot or driveway on the high side, such retaining walls shall be provided with guards that are constructed in accordance with 780 CMR 1021.0 or other approved protective measures.

CHAPTER 19

CONCRETE

780 CMR 1901.0 CONCRETE DESIGN STANDARDS

1901.1 Reinforced and prestressed concrete: Structural members of reinforced concrete, including prestressed concrete, shall be designed and constructed in accordance with the provisions of 780 CMR19 and ACI 318 listed in ***Appendix A***, hereafter referred to in 780 CMR 19 as ACI 318.

1901.2 Plain concrete: Structural members of plain concrete shall be designed and constructed in accordance with the provisions of 780 CMR 19 and ACI 318.1 listed in ***Appendix A***. Concrete that is either unreinforced or contains less reinforcement than the minimum specified for reinforced concrete by ACI 318 shall be classified as plain concrete. Plain concrete shall not be used for structural members where special design considerations are required for blast forces, unless specifically approved.

780 CMR 1902.0 DEFINITIONS

1902.1 General: The following words and terms shall, for the purposes of 780 CMR 19 and as used elsewhere in 780 CMR have the meanings shown herein.

Admixture: Material other than water, aggregate or hydraulic cement, used as an ingredient of concrete and added to concrete before or during mixing to modify the properties of the concrete.

Cementitious material: A material specified in 780 CMR 1906.0 which has cementing value when used in concrete either by itself, such as portland cement or blended hydraulic cements, or when used in combination with portland cement or blended hydraulic cement, such as fly ash, raw or calcined natural pozzolans or ground-granulated blast-furnace slag.

Concrete: A mixture of portland cement or any other hydraulic cement, fine and course aggregates and water, with or without admixtures, of such proportions and manipulation as to meet specific requirements.

Concrete, reinforced: Concrete with no less reinforcement than required by 780 CMR, prestressed or nonprestressed, and designed on the assumption that the two materials act together in resisting forces (see 780 CMR 1901.1).

Member

Primary: Any member of the structural frame of a building or structure used as a column or grillage beam, or to support masonry walls and partitions, including trusses, isolated lintels spanning an opening of eight feet (2438 mm) or more, and any other member required to brace a column or a truss.

Secondary: Any member of the structural framework other than a primary member, including fill-in beams of floor systems.

780 CMR 1903.0 SEISMIC REQUIREMENTS FOR REINFORCED CONCRETE

1903.1 General: The design and construction of reinforced concrete components that resist seismic forces shall conform to the requirements of 780 CMR 1903.0 and ACI 318 except as modified by 780 CMR 1903.1.1.

1903.1.1 Modifications to ACI 318: The sections of ACI 318 shall be modified as indicated in 780 CMR 1903.1.1 items 1 through 13.

1. Modify Section 8.1.2 to read: "except where load combinations of 780 CMR 1616, including seismic forces, are used, design of nonprestressed reinforced concrete members using ***Appendix A***, Alternate Design Method, is permitted."
2. Replace ACI 318 Section 9.2.3 with 780 CMR 1616.
3. Add the following definitions to Section 21.1 of ACI 318:

"Confined region: That portion of a reinforced concrete component in which the concrete is confined by closely spaced special transverse reinforcement restraining the concrete in directions perpendicular to the applied stress."

"Joint: That portion of a column bounded by the highest and lowest surfaces of the other members framing into it."

"Special transverse reinforcement: Reinforcement composed of spirals, closed stirrups, or hoops and supplementary cross ties provided to restrain the concrete and qualify the portion of the component, where used, as a confined region."

4. Replace ACI 318 Sections 21.2.1.3 and 21.2.1.4 with the requirements of 780 CMR 1903.3 through 1903.6.
5. Modify Section 21.2.1.5 to read: "A reinforced concrete structural system not satisfying the requirements of 780 CMR 19, including those composed of precast elements, is allowed if it is demonstrated by experimental evidence and analysis that the proposed system will have strength and toughness equal to or exceeding that provided by a comparable

monolithic reinforced concrete structure satisfying 780 CMR 19."

6. Add the following to the end of Section 21.2.5.1: "Post-tensioning tendons are allowed in flexural members of frames provided the average prestress (f_{pc}) calculated for an area equal to the member's shortest cross-sectional dimension multiplied by the perpendicular dimension, does not exceed 350 psi."

7. Add a new Section 21.3.2.5 to read: "For members in which prestressing tendons are used together with ASTM A706 or A615 (Grades 40 or 60) reinforcement to resist earthquake-induced forces, prestressing tendons shall not provide more than one-quarter of the strength for both positive moments and negative moments at the joint face. Anchorages for tendons shall be demonstrated to perform satisfactorily for seismic loadings. Anchorage assemblies shall withstand, without failure, a minimum of 50 cycles of loading ranging between 40 and 85% of the minimum specified strength of the tendon. Tendons shall extend through exterior joints and be anchored at the exterior face of the joint or beyond."

8. Modify Section 21.3.3.4 to read: "Where hoops are not required, stirrups with 135-degree or greater hooks with six bar diameter but not less than three-inch extensions shall be located throughout the length of the member and spaced not more than one-half the distance from the extreme compression fiber to the centroid of tension reinforcement (d)."

9. Add a new Section 21.4.4.7 to read: "At any section where the nominal strength (ϕP_n) of the column is less than the sum of the shear (V_c) computed in accordance with Section 21.4.5.1 for all of the beams framing into the column above the level under consideration, special transverse reinforcement shall be provided. For beams framing into opposite sides of the column, the moment components are allowed to be assumed to be of opposite sign. For determination of the nominal strength (P_n) of the column, these moments are allowed to be assumed to result from the deformation of the frame in any one principal axis."

10. Add to the end of Section 21.6.1: "A cast-in-place topping on a precast floor system is allowed to serve as a diaphragm provided that the cast-in-place topping is proportioned and detailed to resist the design shear forces. Where untopped precast elements are used as diaphragms, the strength reduction factor (ϕ) for connections between elements shall be 0.5 except that for connection elements that form a continuous tie across and through the untopped element, extending across the diaphragm, the strength reduction factor (ϕ) shall be 0.7."

11. Modify Section 21.6.3 to read: "The design shear force (V_u) shall be obtained from the lateral load analysis in accordance with the factored loads and combinations of loads specified in 780 CMR 1616.0.

12. Renumber existing Sections 21.6.6 through 21.6.8 to Sections 21.6.7 through 21.6.9, respectively, and add a new Section 21.6.6 to read:

21.6.6 Coupling beams: A coupling beam (beam which interconnects two shear walls in their own plane) with clear-span-to-effective-depth ratio (l_n/d) of less than four and with factored shear force (V_u) exceeding $4\sqrt{f'_c}\,b_w d$ shall be provided with shear reinforcement as specified in Sections 21.6.6.1 through 21.6.6.3.

21.6.6.1 Factored shear force (V_u) shall be resisted by two intersecting groups of symmetrical diagonally placed bars extending across the full length of the member and adequately anchored within the shear walls. Each group shall consist of a minimum of four bars providing an area (A_{vd}) not less than that calculated by the following formula:

$$A_{vd} = \frac{V_u}{2f_y \sin\alpha}$$

where: α is the angle between the diagonal reinforcement and the longitudinal axis of the member.

21.6.6.2 Contribution of the diagonal reinforcement to nominal flexural strength of the coupling beam shall be included.

21.6.6.3 Each group of diagonally placed bars shall be enclosed in special transverse reinforcement conforming to Sections 21.4.4.1 through 21.4.4.3. For the purpose of computing A_g in accordance with Equations 10-5 and 21-3, minimum cover as specified in Section 7.7 shall be assumed over each group of diagonally placed reinforcing bars."

13. Modify the title of Section 21.8 to read: "Requirements for Intermediate Moment Frames"

1903.2 Headed bolts and headed stud anchors in concrete: Headed bolts and headed stud anchors shall be solidly cast in concrete. The factored *loads* on embedded headed bolts and headed stud anchors shall not exceed the design strengths determined by 780 CMR 1903.2.2.

1903.2.1 Load factor multipliers: In addition to the *load* factors in 780 CMR 1616.1, a multiplier of 2 shall be used if *special inspection* is not provided, or a multiplier of 1.3 shall be used if *special inspection* is provided. Where anchors are embedded in the tension zone of a member, the *load* factors in 780 CMR 1616.1 shall have a multiplier of 3 if *special inspection* is not provided or of 2 if it is provided.

1903.2.2 Strength of anchors: The strength of headed bolts and headed stud anchors solidly cast in concrete shall be taken as the average of ten tests for each concrete strength and anchor size or calculated in accordance with 780 CMR 1903.2.2.1 through 1903.2.2.3. The loadbearing area of headed anchors shall be at least 1½ times the shank area for anchors of not more than 60,000 psi yield strength.

1903.2.2.1 Strength in tension: The strength of anchors in tension shall be the minimum of P_s or $\phi\ P_c$ where:

$$P_s = 0.9A_b\ f's$$

and

$$\phi P_c = \phi\lambda\ \sqrt{f'_c}(2.8\mathrm{A_s} + 4\mathrm{A_t})$$

where:

A_b = Area (in square inches) of bolt or stud. Must be used with the corresponding steel properties to determine the weakest part of the assembly in tension. In shear, the insert leg is not required to be checked.

A_s = The sloping area (in square inches) of an assumed failure surface. For a single anchor or anchors in a group where the distance between anchors is equal to or greater than twice their embedment length, the surface is assumed to be that of a truncated cone radiating at a 45-degree slope from the loadbearing edge of the anchor to the surface (i.e., $A_t = 0$).

For anchors in a group where the distance between anchors is less than twice their embedment length, the failure surface is assumed to be that of a truncated pyramid radiating at a 45-degree slope from the loadbearing edge of the anchor group to the surface. Additionally, for thin sections with anchor groups, the failure surface shall assumed to follow the extension of this slope through to the far side rather than truncate as in A_t, (i.e., $A_t = 0$), and the failure mode resulting in the lower value of $\phi\ P_c$ shall control.

A_t = The area (in square inches) of the flat bottom of the truncated pyramid of an assumed concrete failure surface. Where anchors in a group are closer than twice their embedment length, the failure surface pyramid is assumed to truncate at the anchor loadbearing edge rather than form separate cones.

f'_c = Specified compressive strength of concrete (psi), which shall not be taken greater than 6,000 psi.

f'_s = Ultimate tensile strength (in psi) of the bolt, stud or insert leg wires, which shall not be taken greater than 60,000 psi. For A307 bolts or A108 studs, f'_s shall be permitted to be assumed to be 60,000 psi.

P_u = Tensile strength required due to factored *loads* (pounds).

V_u = Shear strength required due to factored *loads* (pounds).

λ = One for normal-weight concrete, 0.75 for all lightweight concrete, and 0.85 for sand-lightweight concrete.

ϕ = Strength reduction factor shall be taken as 0.65, except ϕ is permitted to be taken as 0.85 where the anchor is attached to or hooked around reinforcing steel or otherwise terminated so as to transfer effectively forces to reinforcing steel that is designed to distribute forces and avert sudden local failure.

Where the edge distance is less than embedment length, reduce $\phi\ P_c$ proportionately. For multiple edge distances less than the embedment length, use multiple reductions.

1903.2.2.2 Strength in shear: The strength of anchors in shear shall be the minimum of V_s or $\phi\ V_c$ where:

$$V_s = 0.75A_b\ f'_s$$

and where loaded toward an edge greater than ten diameters away:

$$\phi V_c = \phi 800A_b\ \lambda\ \sqrt{f'_c}$$

or where loaded toward an edge less than ten diameters away:

$$\phi Vc = \phi 2\pi d_e^2\ \lambda\ \sqrt{f'_c}$$

where:

d_e = Edge distance from the anchor axis to the free edge.

For groups of anchors, the concrete design shear strength shall be taken as the smallest of:

1. The strength of the weakest anchor times the number of anchors;
2. The strength of the row of anchors nearest the free edge in the direction of shear times the number of rows; or
3. The strength of the row farthest from the free edge in the direction of shear.

For shear loading toward an edge less than ten diameters away, or tension or shear not toward an edge less than four diameters away, reinforcing sufficient to carry the *load* shall be provided to prevent failure of the concrete in tension. In no case shall the edge distance be less than 3⅓ diameters for shear loading toward an edge, or 1⅓ diameters for tension or shear not toward an edge.

1903.2.2.3 Combined tension and shear: Where tension and shear act simultaneously, both of the following shall be met:

$$\frac{1}{\phi}\left[\left(\frac{P_u}{P_c}\right)^2+\left(\frac{V_u}{V_c}\right)^2\right]\le 1$$

and

$$\left[\left(\frac{P_u}{P_s}\right)^2+\left(\frac{V_u}{V_s}\right)^2\right]\le 1$$

1903.2.3 Special provisions for anchor bolts in tops of columns: Anchor bolts at the tops of columns shall be enclosed with not less than two #4 ties located within four inches from the top of the column. Bolts in the tops of columns shall be embedded not less than nine bolt diameters.

1903.3 Moment frames: Moment frames shall comply with 780 CMR 1903.3.1, or 1903.3.2.

1903.3.1 Intermediate moment frames: Intermediate moment frames shall comply with the requirements of Section 21.8 of ACI 318, except as follows:

1903.3.1.1 Transverse reinforcement for frame members subjected principally to bending, where the factored axial compressive force on the members do not exceed ($A_g f'_c/10$), shall comply with Section 21.3.3 of ACI 318.

1903.3.1.2 Transverse reinforcement for frame members subjected to bending and axial load, where the factored axial compressive force on the members exceeds ($A_g f'_c/10$), shall comply with Section 21.4.4 of ACI 318.

1903.3.1.3 Transverse reinforcement as specified in Section 21.4.4 of ACI 318 shall be provided within joints of frames, for the full height of the joints, except that it may be omitted over the depth of the shallowest beam where beams frame into all four sides of columns.

1903.3.1.4 Moment frames composed of two way slabs without beams shall not be used to resist lateral seismic forces. Delete Section 21.8.6 of ACI 318.

1903.3.2 Special moment frames: Special moment frames shall comply with the requirements of Sections 21.2 through 21.5 of ACI 318 as modified in 780 CMR 1903.1.1, and with the requirements of 780 CMR 1903.3.1 for intermediate moment frames.

1903.4 Seismic Performance Category C: Buildings assigned to Seismic Performance Category C shall conform to all of the requirements of ACI 318 as listed in *Appendix A* and to 780 CMR 1903.4.1, 1903.4.2 and 1903.4.3.

1903.4.1 Moment frames: All moment frames that are part of the seismic-resisting system shall be intermediate moment frames conforming to 780 CMR 1903.3.1, or special moment frames conforming to 780 CMR 1903.3.2.

1903.4.2 Discontinuous members: Columns supporting reactions from discontinuous stiff members, such as walls, shall be provided with special transverse reinforcement at the spacing (s_o) as defined in Section 21.9.5.1 of ACI 318 over their full height beneath the level at which the discontinuity occurs. This special transverse reinforcement shall be extended above and below the column as required by Section 21.4.4.5 of ACI 318.

1903.4.3 Shear walls: The design shear strength of shear walls shall be calculated as the maximum shear obtained from design load combinations which include twice the earthquake effect calculated in accordance with the provisions of 780 CMR.

1903.4.4 Shear walls in Dual Systems: Shear walls acting in combination with a moment frame in a Dual System shall conform to sections 21.2 through 21.6 in ACI 318 as modified by 780 CMR 1903.1.1.

1903.5 Seismic Performance Category D: Buildings assigned to Seismic Performance Category D shall conform to all of the requirements for Seismic Performance Category C, and to the requirements of 780 CMR 1903.5.1 through 1903.5.3.

1903.5.1 Moment frames: All moment frames that are part of the seismic-resisting system, regardless of height, shall be special moment frames conforming to 780 CMR 1903.3.2.

1903.5.2 Seismic-resisting system: All materials and components in the seismic-resisting system shall conform to Sections 21.2 through 21.6 in ACI 318, as modified by 780 CMR 1903.1.1.

1903.5.3 Frame members not proportioned to resist earthquake forces: All frame components which are not part of the seismic-resisting system shall conform to 780 CMR 1612.4.4.3.3 and to Section 21.7.1.1 or 21.7.1.2, and Section 21.7.2 of ACI 318.

780 CMR 1904.0 SEISMIC REQUIREMENTS FOR PLAIN CONCRETE

1904.1 General: The design and construction of plain concrete components that resist seismic forces shall conform to the requirements of ACI 318.1 listed in *Appendix A* except as modified by 780 CMR1904.0.

1904.2 Seismic Performance Category C: Structural members of plain concrete in buildings assigned to Seismic Performance Category C shall conform to the requirements of ACI 318.1 listed in

Appendix A and the additional provisions and limitations of 780 CMR 1904.0.

1904.2.1 Footings: Plain concrete footings supporting walls shall be provided with not less than two continuous longitudinal reinforcing bars. Bars shall not be smaller than #4, and shall have a total area of not less than 0.002 times the gross cross-sectional area of the footing. Continuity of reinforcement shall be provided at corners and intersections.

1904.2.2 Pedestals: Plain concrete pedestals shall not be used to resist lateral forces due to earthquake.

1904.2.3 Walls: *Basement* and foundation walls shall be reinforced as specified in ACI 318.1 listed in ***Appendix A***. Other walls shall be reinforced vertically and horizontally as required by 780 CMR 1904.2.3.1 and 1904.2.3.2.

1904.2.3.1 Vertical reinforcement: Vertical reinforcement consisting of at least one #4 bar shall be provided continuously from support to support at each corner, at each side of each opening and at ends of walls or panels.

1904.2.3.2 Horizontal reinforcement: Horizontal reinforcement consisting of at least one #4 bar shall be provided as follows:

1. At the top and bottom of each wall opening, extending not less than 24 inches (610 mm) beyond the sides of the opening; and
2. Continuously at structurally connected roofs and floors, at the top of walls, at the bottom of the wall or in the top of the foundation where the foundation is doweled to the wall, and at a maximum vertical spacing of ten feet (3048 mm).

Reinforcement at the top and bottom of wall openings shall be continuous to qualify as reinforcement required by 780 CMR 1904.2.3.2 item 2.

1904.3 Seismic Performance Category D: Structural members of plain concrete are not permitted in buildings assigned to Seismic Performance Category D.

Exceptions:
1. For occupancies in Use Group R-3 in buildings of wood frame construction, plain concrete footings without longitudinal reinforcement supporting walls, and plain concrete column footings are permitted.
2. In all other buildings, plain concrete footings supporting walls shall be permitted provided that such footings are reinforced longitudinally as specified in 780 CMR 1904.2.1.
3. For occupancies in Use Group R-3, plain concrete foundation or *basement* walls having a thickness of not less than 7½ inches (191 mm) and retaining four feet (1219 mm) or less of unbalanced fill shall be permitted.

780 CMR 1905.0 MINIMUM SLAB THICKNESS

1905.1 General: The thickness of concrete floor slabs supported directly on the ground shall not be less than 3½ inches (89 mm). A 6-mil (0.006 inch; 152 μm) polyethylene *vapor retarder* with joints lapped not less than six inches (152 mm) shall be placed between the base course or subgrade and the concrete floor slab, or other approved equivalent methods or materials shall be used to retard vapor transmission through the floor slab.

Exception: A *vapor retarder* is not required:
1. For detached *structures accessory* to occupancies in Use Group R-3, such as garages, utility buildings or other unheated facilities;
2. For unheated storage rooms having an area of less than 70 square feet (6.5 m^2) and carports attached to occupancies in Use Group R-3;
3.. For buildings of other use groups where migration of moisture through the slab from below will not be detrimental to the intended occupancy of the building;
4. For driveways, walks, patios and other flatwork which will not be enclosed at a later date; or
5. Where approved based upon local site conditions.

780 CMR 1906.0 MATERIALS

1906.1 General: Materials used to produce concrete and admixtures for concrete shall comply with the requirements of 780 CMR 1906.0 and ACI 318.

1906.2 Cements: Cement shall conform to ASTM C150 listed in ***Appendix A***, or to such other cements as listed in ACI 318.

1906.3 Aggregates: Concrete aggregates shall conform to ASTM C33 or to ASTM C330 listed in ***Appendix A***.

1906.3.1 Special tests: Aggregates failing to meet the specifications listed in 780 CMR 1906.3 shall not be used unless approved and shown by special test or actual service to produce concrete of adequate strength and durability.

1906.3.2 Nominal size: Nominal maximum size of coarse aggregate shall not be larger than:
1. 1/5 of the narrowest dimension between sides of forms;
2. ⅓ of the depth of slabs; nor
3. ¾ of the minimum clear spacing between individual reinforcing bars or wires, bundles of bars, or prestressing tendons or ducts.

Exception: These limitations shall not apply where information is submitted by the engineer and is approved showing that the workability and methods of consolidation are such that concrete will be placed without honeycomb or voids.

1906.4 Water: Water used in mixing concrete shall be clean and free from injurious amounts of oils, acids, alkalis, salts, organic materials or other substances that are deleterious to concrete or reinforcement.

1906.4.1 Chloride ions: Mixing water for prestressed concrete or for concrete that will contain aluminum embedments, including that portion of mixing water contributed in the form of free moisture on aggregates, shall not contain deleterious amounts of chloride ion (see 780 CMR 1907.1.4).

1906.4.2 Potability: Nonpotable water shall not be used in concrete unless the specific requirements of ACI 318 allowing the use of nonpotable water are satisfied.

1906.5 Metal reinforcement: Reinforcement and welding of reinforcement to be placed in concrete construction shall conform to the requirements of 780 CMR 1906.5

1906.5.1 Reinforcement Type: Reinforcement shall be of the deformed type, except for plain reinforcement used for spirals or tendons and reinforcement consisting of structural steel, steel pipe or steel tubing as specified in ACI 318. Reinforcement shall conform to the applicable ASTM standards listed in ACI 318.

1906.5.2 Welding: Reinforcing bars to be welded shall be indicated on the drawings, and the welding procedure to be used shall be specified. ASTM reinforcing bar specifications, except for ASTM A706 listed in *Appendix* A, shall be supplemented to require a report of material properties necessary to conform to welding procedures specified in AWS D1.4 listed in *Appendix A*.

1906.5.3 Tests: Where unidentified reinforcement is approved for use, not less than three tension and three bending tests shall be made on representative specimens of the reinforcement from each shipment and grade of reinforcing steel proposed for use in the work.

1906.6 Admixtures: Admixtures used in concrete shall comply with 780 CMR 1906.6.1 through 1906.6.4.

1906.6.1 Chloride: Calcium chloride or admixtures containing chloride from other than impurities from admixture ingredients shall not be used in prestressed concrete, in concrete containing embedded aluminum, in concrete cast against stay-in-place galvanized metal forms, or in concrete to be exposed to severe or very severe sulfate-containing solutions as defined in ACI 318 (see 780 CMR 1907.1.3 and 1907.1.4).

1906.6.2 Standards: Air-entraining admixtures shall conform to ASTM C260 listed in *Appendix A*. Water-reducing admixtures, retarding admixtures, accelerating admixtures, water-reducing and retarding admixtures, and water-reducing and accelerating admixtures shall conform to ASTM C494 listed in *Appendix A*.

1906.6.3 Pozzolans: Fly ash or other pozzolans used as admixtures shall conform to ASTM C618 listed in *Appendix A*.

1906.6.4 Blast-furnace slag: Ground-granulated blast-furnace slag used as an admixture shall conform to ASTM C989 listed in *Appendix A*.

1906.7 Tests of materials: Tests of concrete and the materials used in concrete shall be in accordance with ACI 318.

780 CMR 1907.0 DURABILITY REQUIREMENTS

1907.1 Durability requirements: Where concrete is exposed to special conditions as described in 780 CMR 1907.1.1 through 1907.1.5, the requirements set forth in 780 CMR 1907.1.1 through 1907.1.5 shall be met.

1907.1.1 Freezing and thawing and deicer chemicals: Normal weight and lightweight concrete exposed to freezing and thawing or deicer chemicals shall be air entrained with the air content indicated in Table 1907.1.1. Tolerance on air content as delivered shall be ± 1.5%. For a specified compressive strength (f'_c) greater than 5,000 psi (34475 kPa), the required air content indicated in Table 1907.1.1 shall be reduced by 1%. Where finely divided materials of fly ash or natural pozzolans are used as mineral admixtures (see 780 CMR 1906.6.3) in air-entrained portland cement concrete, air content tests shall be made in accordance with ASTM C231 listed in *Appendix A*, to assure compliance with the air content requirements of Table 1907.1.1. The frequency of air content tests shall be the same as that for strength tests required by 780 CMR 1908.3.1.

Table 1907.1.1
TOTAL AIR CONTENT FOR FROST-RESISTANT CONCRETE

Nominal maximum aggregate size[b] (inches)	Air content, percent	
	severe[a] exposure	Moderate[a] exposure
⅜	7½	6
½	7	5½
¾	6	5
1	6	4½
1½	5½	4½
2[c]	5	4
3[c]	4½	3½

Note a. The severe and moderate exposures referenced in this table are not based upon the weathering regions shown in figure 1907.1.2. For the purposes of 780 CMR 1907, severe and moderate exposures shall be defined as follows:

Severe exposure occurs when concrete will be in almost continuous contact with moisture prior to freezing, or where deicing salts are used. Examples are pavements, bridge decks, sidewalks, parking garages and water tanks.

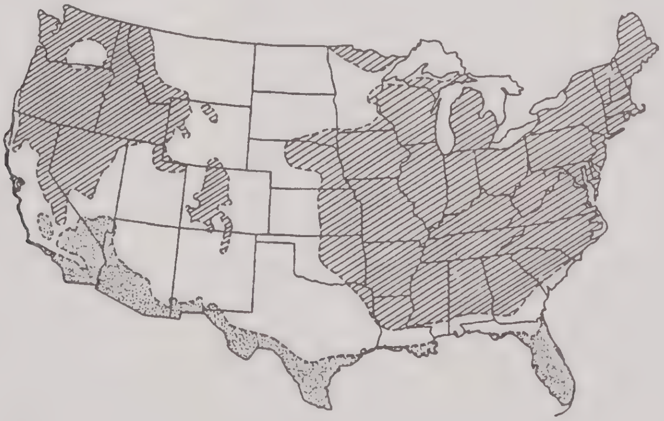
Moderate exposure occurs when concrete will be only occasionally exposed to moisture prior to freezing, and where deicing salts are not used. Examples are certain exterior walls, beams, girders and slabs not in direct contact with soil.

Note b. See ASTM C33 listed in *Appendix A* for oversize tolerances for various nominal maximum size designations.

Note c. These air contents apply to total mix, as for the preceding aggregate sizes. When testing these concretes, however, aggregate larger than 1½ inches is removed by handpicking or sieving and air content is determined on the minus-1½-inch fraction of mix. (Tolerance on air content as delivered applies to this value.) Air content of the total mix is computed from the value determined on the minus-1½-inch fraction.

1907.1.2 Water-cementitious material ratio and strength: For occupancies and appurtenances thereto in Use Group R-3, and occupancies in Use Group R-2 that are in buildings less than four stories in *height*, normal-weight aggregate concrete that is subject to weathering (freezing and thawing), as determined from Figure 1907.1.2, or deicer chemicals shall comply with the requirements of Table 1907.1.2(1). In all other buildings, concrete that is intended to have a low permeability to water. or concrete that will be subject to freezing and thawing in a moist condition or that will be exposed to deicing salts, brackish water, sea water or spray from these sources, shall conform to the requirements of Table 1907.1.2(2). Additionally, concrete that will be exposed to deicing chemicals shall conform to the limitations of 780 CMR1907.1.2.2.

Figure 1907.1.2
Weathering Probability Map for Concrete[a]



Severe - (Over 500°) ▨

Moderate - (100 to 500°) ☐

Negligible (Under 100°) ▒

Weathering Regions (Weathering Index)[b]

Note a. Lines defining areas are approximate only. Local conditions can be more or less severe than indicated by the region classification.

Note b. Data needed to determine the weathering index for any locality can be found or estimated from the *Tables of Local Climatological Data*, published by the National Oceanic & Atmospheric Administration, U.S. Department of Commerce.

Table 1907.1.2(1) MINIMUM SPECIFIED COMPRESSIVE STRENGTH (f'_c)[c]

Type of location of concrete construction	Minimum specified compressive strength (f'_c at 28 days, psi)		
	Negligible exposure	Moderate exposure	Severe exposure
Basement walls and foundations not exposed to the weather	2,500	2,500	2,500[a]
Basement slabs and interior slabs on grade, except garage floor slabs	2.500	2,500	2,500[a]
Basement walls, foundation walls, exterior walls and other vertical concrete surfaces exposed to the weather	2,500	3,000[b]	3,000[b]
Driveways, curbs, walks, patios, porches, carport slabs, steps and other flatwork exposed to the weather, and garage floor slabs	2,500	3,000[b]	3,500[b]

Note a. Concrete in these locations which can be subjected to freezing and thawing during construction shall be of air-entrained concrete in accordance with Table 1907.1.1.

Note b. Concrete shall be air entrained in accordance with Table 1907.1.1.

Note c. 1 psi = 6.895 kPa.

Table 1907.1.2(2) REQUIREMENTS FOR SPECIAL EXPOSURE CONDITIONS

Exposure condition	Maximum water cementitious materials ratio (by weight), normal-weight aggregate concrete	Minimum f'_c normal-weight and lightweight aggregate concrete (psi)[a]
Concrete intended to have low permeability when exposed to water	0.50	4,000
Concrete exposed to freezing and thawing in a moist condition	0.45	4,500
For corrosion protection for reinforced concrete exposed to deicing salts, brackish water, seawater or spray from these sources	0.40	5,000

Note a. 1 psi = 6.895 kPa.

1907.1.2.1 Calculation of water-cementitious material ratio: To determine compliance with the maximum water-cementitious material ratio requirement of Table 1907.1.2(2), the weight of cementitious material shall include weights of any of the following if contained in the concrete mixture: cement conforming to the requirements of ASTM C150 or C595; fly ash or other pozzolan conforming to the requirements of ASTM C618; and ground-granulated blast-furnace slag conforming to the requirements of ASTM C989 listed in *Appendix A*.

1907.1.2.2 Limitations on use of certain cementitious materials: For concrete exposed to deicing chemicals, the maximum weight of fly ash or other pozzolan, or ground granulated blast-furnace slag that is included in the calculation of water-cementitious material ratio, shall not exceed the percentages of the total weight of cementitious material specified in 780 CMR 1907.1.2.2.1 through 1907.1.2 2.3.

1907.1.2.2.1 Concrete containing fly ash or pozzolan: The combined weight of fly ash and other pozzolan conforming to ASTM C618 listed in *Appendix A*. shall not exceed 25% of the total weight of cementitious materials. Fly ash or other pozzolan used to manufacture Type IP or IPM blended hydraulic cement conforming to ASTM C595 listed in *Appendix A* shall be included with fly ash or other pozzolan added as an admixture.

1907.1.2.2.2 Concrete containing ground-granulated blast-furnace slag: The weight of ground-granulated blast-furnace slag conforming to ASTM C989 listed in *Appendix A* shall not exceed 50% of the total weight of cementitious materials. Slag used to manufacture Type IS or ISM blended hydraulic cement conforming to ASTM C595 listed in *Appendix A* shall be included with slag added as an admixture.

1907.1.2.2.3 Concrete containing fly ash or pozzolan and slag: If fly ash or other pozzolan and slag are used in concrete, portland cement conforming to ASTM C150 listed in *Appendix A* shall constitute not less than 50% of the total weight of cementitious materials. Fly ash or other pozzolan shall constitute not more than 25% of the total weight of cementitious materials. See 780 CMR 1907.1.2.2.1.

1907.1.3 Protection from sulfate: Concrete that will be exposed to sulfate-containing solutions or soils shall conform to the requirements for such exposure in ACI 318.

1907.1.4 Corrosion resistance: For corrosion resistance, the maximum water-soluble chloride ion concentrations in concrete shall not exceed the limitations established in ACI 318.

1907.1.5 Protection from salt: Where reinforced concrete will be exposed to deicing chemicals, salts, brackish water, sea water or spray from these sources, the requirements of Table 1907.1.2(2) for the water-cementitious material ratio, or the concrete strength and minimum concrete cover requirements of 780 CMR 1910.6, shall be satisfied.

780 CMR 1908.0 CONCRETE QUALITY, MIXING AND PLACING

1908.1 General: Concrete shall be proportioned to provide an average compressive strength as prescribed by ACI 318, and to satisfy the durability criteria of 780 CMR 1907.0. Concrete shall be produced to minimize frequency of strengths below f'_c as prescribed in 780 CMR 1908.3.2. The specified compressive strength (f'_c) for concrete designed and constructed in accordance with this chapter shall not be less than 2,500 psi (17238 kPa).

Unless otherwise specified, f'_c shall be based on 28-day strength. If other than 28 days is used in the design, the length of time to reach f'_c shall be indicated on the *construction documents*.

1908.2 Selection of concrete proportions: Concrete proportions shall be determined in accordance with ACI 318 and as modified in 780 CMR1908.

1908.2.1 Proportioning by water-cementitious material ratio: If data based on field experience or trial mixture as required by ACI 318 are not available, concrete proportions shall be based on the water-cementitious material ratio limitations shown in Table 1908.2.1, subject to approval. The specified compressive strengths in Table 1908.2.1 are 28-day strengths for cements conforming to the strength limitations of ASTM C150 listed in ACI 318, Type I, IA, II or IIA and seven-day strengths for Types III and IIIA. For strengths above 3,500 psi (24133 kPa), concrete proportioned by the water-cementitious material ratio shall be established by the methods listed in ACI 318.

Table 1908.2.1
MAXIMUM WATER-CEMENTITIOUS MATERIAL RATIOS AND MINIMUM CEMENT CONTENTS

Specified compressive strength[a] (psi)	Minimum sacks of cement per cubic yard of concrete	Maximum permissible water-cementitious material ratios[a]			
		Nonair-entrained concrete		Air-entrained concrete	
		Absolute ratio by weight	US gallon per 94 pound bag of cement	Absolute ratio by weight	US gallon per 94 pound bag of cement
2,500	5	0.67	7.6	0.54	6.1
3,000	5½	0.58	6.6	0.46	5.2
3,500	6	0.51	5.8	0.40	4.5

Note a. 1 psi -6.895 kPa; 1 gallon = .00379 m^3; 1 pound = 0.454 kg.

1908.2.2 Limitation on use: Table 1908.2.1 shall be used only for concrete to be made with cements conforming to the strength requirements for Type I, IA, II, IIA, III, IIIA or V of ASTM C 150 listed in ***Appendix A*** or Type IS, IS-A, IS(MS), IS-A(MS), I(SM), I(SM)-A, IP, IP-A, I(PM), I(PM)-A, IP(MS), IP-A(MS) or P of ASTM C595 listed in ***Appendix A*** and shall not be applied to concrete containing lightweight aggregates or admixtures other than those for entraining air.

1908.2.3 Durability requirements: Concrete proportioned by the water-cementitious material ratio limitations prescribed in Table 1908.2.1 shall also conform to the durability requirements of 780 CMR 1907.0 and to compressive strength test criteria of 780 CMR1908.3.

1908.3 Evaluation for acceptance of concrete: For evaluation and acceptance of concrete, the procedures established in 780 CMR 1908.3.1 through 1908.3.4 shall be followed.

1908.3.1 Frequency of testing: Testing shall be conducted as required by the following:

1. Samples for strength tests of each class of concrete placed each day shall be taken not less than once a day, nor less than once for each 150 cubic yards (115 m^3) of concrete, nor less than once for each 5,000 square feet (465 m^2) of surface area for slabs or walls.
2. On a given project, if the total volume of concrete is such that the frequency of testing required by 780 CMR 1908.3.1, item 1, provides less than five strength tests for a given class of concrete, tests shall be made from at least five randomly selected batches or from each batch if fewer than five batches are used.
3. Where total quantity of a given class of concrete is less than 50 cubic yards (38 m^3), strength tests are not required when approved and evidence of satisfactory strength is provided. Satisfactory evidence shall include, but not be limited to, certification from the concrete supplier that the concrete to be provided will be proportioned to achieve the specified compressive strength based on "field experience" or "trial batches" in accordance with ACI 318. In the absence of satisfactory evidence, concrete shall be proportioned in accordance with Table 1908.2.1.
4. A strength test shall be the average of the strengths of two cylinders made from the same sample of concrete and tested at 28 days or at the test age designated for determination of f'_c

1908.3.2 Laboratory-cured specimens: Laboratory-cured specimens shall conform to the following criteria:

1. Samples for strength tests shall be taken in accordance with ASTM C172 listed in ***Appendix A***.
2. Cylinders for strength tests shall be molded and laboratory cured in accordance with

ASTM C31 listed in *Appendix A*, and tested in accordance with ASTM C39 listed in *Appendix A*.

3. Strength level of an individual class of concrete shall be considered satisfactory if both of the following requirements are met:
   3.1. Average of all sets of three consecutive strength tests equals or exceeds f'_c; and
   3.2. All individual strength tests (average of two cylinders) shall not fall below f'_c by more than 500 psi (3448 kPa).

4. If either of the requirements of 780 CMR 1908.3.2, item 3, is not met, steps shall be taken to increase the average of subsequent strength test results. The requirements of 780 CMR 1908.3.4 shall apply if the requirement in 780 CMR 1908.3.2, item 3.2, is not met.

1908.3.3 Field-cured specimens: Where the code official requires strength tests of cylinders cured under field conditions to check adequacy of curing and protection of concrete in the structure, the field-cured specimens shall conform to the following criteria:

1. Field-cured cylinders shall be cured under field conditions in accordance with ASTM C31 listed in *Appendix A*.
2. Field-cured test cylinders shall be molded at the same time and from the same samples as laboratory-cured test cylinders.
3. Procedures for protecting and curing concrete shall be improved where the strength of field-cured cylinders at the test age designated for determination of f'_c is less than 85% of that of companion laboratory-cured cylinders. The 85% criterion is not required where the field-cured strength exceeds f'_c by more than 500 psi (3448 kPa).

1908.3.4 Investigation of low-strength test results: If the investigation of concrete indicates low-strength conditions, the following procedures shall apply:

1. If any strength test (see 780 CMR 1908.3.1, item 4) of laboratory-cured cylinders falls below the specified value of f'_c by more than 500 psi (3448 kPa) (see 780 CMR 1908.3.2, item 3.2) or if tests of field-cured cylinders indicate deficiencies in protection and curing (see 780 CMR 1908.3.3, item 3), steps shall be taken to assure that the loadbearing capacity of the structure is not jeopardized.
2. If the likelihood of low-strength concrete is confirmed and computations indicate that the loadbearing capacity will be significantly reduced, tests of cores drilled from the area in question shall be made in accordance with ACI 318.
3. Concrete in an area represented by core tests shall be considered structurally adequate if the average of three cores is not less than 85% of f'_c and if a single core is not less than 75% of f'_c. Where necessary to check testing accuracy, locations represented by erratic core strengths shall be retested.
4. If the criteria of 780 CMR 1908.3.4, item 3, are not met, and if structural adequacy remains in doubt, load tests shall be ordered at the discretion of the engineer or the code official as outlined in Chapter 20 of ACI 318 for the questionable portion of the structure, or other appropriate action taken.

1908.4 Preparation of equipment and place of deposit: Preparation before concrete placement shall include the following criteria:

1. All equipment for mixing and transporting concrete shall be clean.
2. All debris and ice shall be removed from spaces to be occupied by concrete.
3. Forms shall be properly coated.
4. Masonry filler units that will be in contact with concrete shall be well drenched.
5. Reinforcement shall be thoroughly clean of ice or other deleterious coating.
6. Water shall be removed from the place of deposit before concrete is placed, unless a extreme is to be used or unless otherwise approved by the code official.
7. All laitance and other unsound material shall be removed before additional concrete is placed against hardened concrete.

1908.5 Mixing: All concrete shall be mixed until there is a uniform distribution of materials, and shall be discharged completely before the mixer is recharged.

1908.5.1 Ready-mixed concrete: Ready-mixed concrete shall be mixed and delivered in accordance with ASTM C94 or ASTM C685 listed in *Appendix A*.

1908.5.2 Job-mixed concrete: Job-mixed concrete shall be mixed in accordance with ACI 318.

1908.6 Conveying: Concrete shall be conveyed from the mixer to the place of final deposit by methods that will prevent separation or loss of materials. Conveying equipment shall be capable of providing a supply of concrete at the site of placement without separation of ingredients and without interruptions sufficient to permit loss of plasticity between successive increments.

1908.7 Depositing: Concrete shall be deposited as nearly as practicable in its final position to avoid segregation caused by rehandling or flowing.

1908.7.1 Placement timing: Concrete placement shall be carried on at such a rate that the concrete is at all times plastic and flows readily into spaces between reinforcement.

1908.7.2 Unacceptable concrete: Concrete that has partially hardened or has been contaminated by foreign materials shall not be deposited in the structure.

1908.7.3 Retempering: Retempered concrete or concrete that has been remixed after initial set shall not be used unless approved by the *registered design professional*.

1908.7.4 Continuous concreting: Once started, concreting shall be carried on as a continuous operation until the placement of a panel or section, as defined by panel or section boundaries or predetermined joints, is completed except as provided for in 780 CMR 1909.4.

1908.7.5 Placement in walls: Top surfaces of vertically formed lifts shall be generally level.

1908.7.6 Construction joints: Where construction joints are required, such joints shall be made in accordance with 780 CMR 1909.4.

1908.7.7 Consolidation: All concrete shall be thoroughly consolidated by suitable means during placement and shall be thoroughly worked around reinforcement and embedded fixtures and into corners of forms.

1908.8 Curing: Concrete (other than high-early-strength) shall be maintained above 50°F (10°C) and in a moist condition for at least the first seven days after placement, except when cured in accordance with 780 CMR 1908.8.2.

1908.8.1 High-early-strength concrete: High-early-strength concrete shall be maintained above 50°F (10°C) and in a moist condition for at least the first three days after placement, except when cured in accordance with 780 CMR 1908.8.2.

1908.8.2 Accelerated curing: If curing is to be accelerated, such curing shall be done in accordance with ACI 318.

1908.9 Cold-weather requirements: Adequate equipment shall be provided for heating concrete materials and protecting concrete during freezing or near-freezing weather.

1908.9.1 Frost: All concrete materials and all reinforcement, forms, fillers and ground with which concrete is to come in contact shall be free from frost.

1908.9.2 Ice: Frozen materials or materials containing ice shall not be used.

1908.10 Hot-weather requirements: During hot weather, attention shall be given to ingredients, production methods, handling, placing, protection and curing to prevent excessive concrete temperatures or water evaporation that would impair required strength or serviceability of the member or structure.

780 CMR 1909.0 FORMWORK, EMBEDDED PIPES AND CONSTRUCTION JOINTS

1909.1 Design of formwork: The design, fabrication and erection of forms shall result in a final structure that conforms to shapes, lines and dimensions of the members as required by the *construction documents*.

1909.1.1 Form strength: Forms shall be substantial and shall be sufficiently tight to prevent leakage of concrete.

1909.1.2 Form bracing: Forms shall be properly braced or tied together to maintain position and shape.

1909.1.3 Form placement: Forms and their supports shall be designed so as not to damage previously placed structures.

1909.2 Removal of forms and shores: Construction *loads* shall not be supported on, nor any shoring removed from, any part of the structure under construction except where that portion of the structure, in combination with the remaining forming and shoring system, has sufficient strength to support safely its weight and *loads* placed thereon.

1909.2.1 Structural analysis: Sufficient strength shall be demonstrated by structural analysis considering proposed *loads*, strength of the forming and shoring system, and concrete strength data. Concrete strength data shall be based on tests of field-cured cylinders or, where approved, on other procedures to evaluate concrete strength. Structural analysis and concrete-strength test data shall be furnished to the code official when so required.

1909.2.2 Construction loads: Construction *loads* exceeding the combination of superimposed *dead load* plus specified *live load* shall not be supported on any unshored portion of the structure under construction, unless analysis indicates adequate strength to support such additional *loads*.

1909.2.3 Safety: Forms shall be removed in such a manner so as not to impair safety and serviceability of the structure. All concrete to be exposed by form removal shall have sufficient strength not to be damaged thereby.

1909.2.4 Prestressed members: Form supports for prestressed concrete members shall not be removed unless sufficient prestressing has been applied to enable prestressed members to carry their *dead load* and anticipated construction *loads*.

1909.3 Conduits and pipes embedded in concrete: Where conduits, pipes and sleeves of any material not harmful to concrete and within limitations of

780 CMR 1909 are embedded in concrete with the approval of the engineer, such embedments shall not be considered to replace structurally the displaced concrete, except as provided for in 780 CMR 1909.3.5.

1909.3.1 Aluminum conduit and pipe: Conduits and pipes of aluminum shall not be embedded in structural concrete unless effectively coated or covered to prevent aluminum concrete reaction or electrolytic action between aluminum and steel.

1909.3.2 Structural effect: Conduits, pipes and sleeves passing through a slab, wall or beam shall not impair significantly the strength of the construction.

1909.3.3 Columns: Conduits and pipes, including fittings, embedded within a column, shall not displace more than 4% of the area of the cross section on which strength is calculated or which is required for fire protection.

1909.3.4 Slabs, walls or beams: Except where *construction documents* for conduits and pipes are approved by the *registered design professional* and the code official, conduits and pipes embedded within a slab, wall or beam (other than those merely passing through) shall:

1. Not be larger in outside dimension than ⅓ of the overall thickness of the slab, wall or beam in which such conduits and pipes are embedded.
2. Not be spaced closer than three diameters or widths on center.
3. Not impair significantly the strength of the construction.

1909.3.5 Displaced concrete: Conduits, pipes and sleeves shall not be considered in compression as replacing structurally the displaced concrete unless such conduits, pipes and sleeves:

1. Are not exposed to rusting or other deterioration.
2. Are of uncoated or galvanized iron or steel not thinner than standard Schedule 40 steel pipe.
3. Have a nominal inside diameter not over two inches and are spaced not less than three diameters on center.

1909.3.6 Additional considerations: In addition to the other requirements of 780 CMR 1909.3, pipes that will contain liquid, gas or vapor which are embedded in structural concrete shall conform to the following conditions:

1. Pipes and fittings shall be designed to resist effects of the material, pressure and temperature to which the pipes and fittings will be subjected.
2. Liquid, gas or vapor except water not exceeding 90°F (32°C) or 50 psi (345 kPa) pressure, shall not be placed in the pipes until the concrete has attained design strength.
3. In solid slabs, piping that is not used for radiant heating or snow melting shall be placed between top and bottom reinforcement.
4. Concrete cover for pipes, conduit and fittings shall not be less than 1½ inches (38 mm) for concrete exposed to earth or weather conditions or ¾ inch (19 m) for concrete not exposed to weather conditions or in contact with ground.
5. Reinforcement with an area of not less than 0.002 times the area of the concrete section shall be provided normal to piping.
6. Piping and conduit shall be fabricated and installed so that cutting, bending or displacement of reinforcement from the proper location will not be required.

1909.4 Construction joints: Construction joints shall be created using the procedures set forth in 780 CMR 1909.4.1 through 1909.4.6.

1909.4.1 Surface cleaning: Surface of concrete construction joints shall be cleaned and laitance removed.

1909.4.2 Preparation of joint: Immediately before new concrete is placed, all construction joints shall be wetted and standing water shall be removed.

1909.4.3 Effect on strength: Construction joints shall be so made and located as not to impair the strength of the structure. Provisions shall be made for the transfer of shear and other forces through construction joints.

1909.4.4 Location of joints: Construction joints in floors shall be located within the middle third of the spans of slabs, beams and girders. Joints in girders shall be offset a minimum distance of two times the width of intersecting beams.

1909.4.5 Support conditions: Beams, girders or slabs supported by columns or walls shall not be cast or erected until concrete in the vertical support members is not in a plastic state.

1909.4.6 Monolithic pours: Beams, girders, haunches, drop panels and capitals shall be placed monolithically as part of a slab system, unless otherwise shown on the *construction documents*.

780 CMR 1910.0 DETAILS OF REINFORCEMENT

1910.1 General: Details of reinforcement shall comply with the requirements of 780 CMR 1910.0 and ACI 318. Where unidentified reinforcement is approved for use, such reinforcement shall be tested in accordance with the following:

Not less than three tension and three bending tests shall be made on representative specimens of the reinforcement from each shipment and grade of reinforcing steel proposed for use in the project.

1910.2 Bending reinforcement: All reinforcement shall be bent cold, unless otherwise permitted by the *registered design professional* and approved. Reinforcement partially embedded in concrete shall

NON-TEXT PAGE

not be field bent, except as shown on the construction documents or as authorized by the *registered design professional* and approved.

1910.3 Surface conditions of reinforcement: At the time concrete is placed, metal reinforcement shall be free from mud, oil or other nonmetallic coatings that adversely affect bonding capability.

1910.3.1 Rust or mill scale: Metal reinforcement, except prestressing tendons, with rust or mill scale, or a combination of both, shall be considered satisfactory, provided that the minimum dimensions (including height of deformations) and the weight of a hand-wire-brushed test specimen are not less than the specification requirements of the applicable ASTM standard referenced by ACI 318.

1910.3.2 Prestressing tendons: Prestressing tendons shall be clean and free of oil, dirt, scale, pitting and excessive rust. A light oxide is permissible.

1910.4 Placing reinforcement: Reinforcement, prestressing tendons and ducts shall be accurately placed and supported before concrete is placed, and shall be secured against displacement within the tolerances permitted in 780 CMR 1910.4.1 through 1910.4.3.

Exception: Embedded items (such as dowels or inserts) of precast concrete members that either protrude from concrete or remain exposed for inspection shall not be embedded while the concrete is in a plastic state unless authorized by the *registered design professional* and the following conditions are met:

1. Embedded items are not required to be hooked or tied to reinforcement.
2. Embedded items shall be maintained in the correct position while concrete remains plastic.
3. Embedded items shall be properly anchored to develop required factored *loads*.

1910.4.1 Reinforcement, prestressing tendons and pretressing ducts: Unless otherwise specified by the engineer, reinforcement, prestressing tendons and prestressing ducts shall be placed within the following tolerances:

1. The tolerance for depth (*d*) and the minimum concrete cover in flexural members, walls and compression members shall be as specified in Table 1910.4.1, except that the tolerance for the clear distance to formed soffits shall be minus ¼ inch (6 mm) and the tolerance for cover shall not exceed minus one-third of the minimum concrete cover required in the design drawings or specifications.
2. The tolerance for longitudinal location of bends and ends of reinforcement shall be ± 2 inches (51 mm) except at discontinuous ends of members where the tolerance shall be ½ inch (13 mm).

Table 1910.4.1
TOLERANCES[a]

Depth (*d*)	Toleramce on *d*	Tolerance on *d* minimum concrete cover
d less than or equal to 8 inches	±3/8 inch	-3/8 inch
d greater than 8 inches	±1/2 inch	-1/2 inch

Note a. 1 inch = 25.4 mm

1910.4.2 Welded wire fabric: Where welded wire fabric (with wire size not greater than W5 or D5) used in slabs not exceeding ten feet (3048 mm) in span is curved from a point near the top of slab over the support to a point near the bottom of slab at midspan, such reinforcement shall be either continuous over, or securely anchored at, the support.

1910.4.3 Welding: Welding of crossing bars shall not be permitted for assembly of reinforcement unless authorized by the engineer.

1910.5 Spacing limitations for reinforcement: The clear distance between reinforcing bars, bundled bars, prestressing tendons and ducts shall be in accordance with the limitations of ACI 318.

1910.6 Concrete protection for reinforcement: Reinforcement shall be provided with the protection required by 780 CMR 1910.6.1 through 1910.6.5.

1910.6.1 Cast-in-place concrete: In cast-in-place concrete (nonprestressed), the minimum concrete cover for reinforcement shall be as indicated in Table 1910.6.1.

Table 1910.6.1
MINIMUM COVER

Structural element and condition	Minimum cover (inches)[a]
1. Concrete cast against and permanently exposed to earth	3
2. Concrete exposed to earth or weather:	
#6 through #18 bars	2
#5 bar, W31 or D31 wire and smaller	1½
3. Concrete not exposed to weather or in contact with ground	
Slabs, walls, joists	
#14 and #18 bars	1½
#11 bar and smaller	¾
Beams, columns:	
Primary reinforcement, ties, stirrups, spirals	1½
Shells, folded plate members:	
#6 bar and larger	¾
#5 bar, W31 or D31 wire, and smaller	½

Note a. 1 inch = 25.4 mm.

1910.6.2 Precast concrete: The minimum cover for reinforcement in precast concrete manufactured under plant control conditions and for prestressed concrete shall be in accordance with ACI 318.

1910.6.3 Corrosive environments: In corrosive environments or other severe conditions, the amount of concrete protection shall be suitably increased, and the density and nonporosity of protection concrete shall be considered, or other protection shall be provided.

1910.6.4 Future extensions: Exposed reinforcement, inserts and plates intended for bonding with future extensions shall be protected from corrosion.

1910.6.5 Fire protection: Where this code requires a thickness of cover for fire protection greater than the minimum concrete cover specified in 780 CMR 1910.6.1 or ACI 318, such greater thickness shall be used.

780 CMR 1911.0 SHOTCRETE

1911.1 General: Except as specified in 780 CMR 911.0, shotcrete shall conform to the requirements for plain concrete or reinforced concrete. Shotcrete is mortar or concrete which is pneumatically projected at a high velocity onto a surface.

1911.2 Proportioning: Shotcrete proportions shall be selected that allow suitable placement procedures using the delivery equipment selected, and that results in in-place hardened shotcrete conforming to the strength requirements of 780 CMR.

1911.3 Aggregate: Coarse aggregate, if used, shall not exceed ¾ inch (19 mm) in size.

1911.4 Reinforcement: Reinforcement shall comply with 780 CMR 1911.4.1 through 1911.4.3.

1911.4.1 Size: The maximum size of reinforcement shall be No. 5 bars. The code official shall approve the use of larger bars where it is demonstrated that adequate encasement of the larger bars will be achieved.

1911.4.2 Spacing: The minimum clearance between parallel reinforcing bars shall be 2½ inches (64 mm). Welded wire fabric shall have a minimum wire spacing of two inches (51 mm) by two inches (51 mm).

1911.4.3 Splices: Lap splices of reinforcing bars shall be by the noncontact lap-splice method with at least two inches (51 mm) of clearance between bars. The code official shall permit the use of contact lap splices where necessary for the support of the reinforcing and provided that it is demonstrated that adequate encasement of the bars at the splice will be achieved.

1911.5 Rebound: Any rebound or accumulated loose aggregate shall be removed from the surfaces to be covered prior to placing the initial or any succeeding layers of shotcrete. Rebound shall not be reused as aggregate.

1911.6 Joints: Except where permitted herein, unfinished work shall not be allowed to stand for more than 30 minutes unless all edges are sloped to a thin edge. For structural elements which will be under compression and for construction joints shown on the approved (*construction documents*, square joints are permitted. Before placing additional material adjacent to previously applied work, sloping and square edges shall be cleaned and wetted.

1911.7 Damage: Shotcrete that exhibits sags, sloughs, segregation, honeycombing, sand pockets or other obvious defects, shall be removed and replaced.

1911.8 Curing: During the curing periods specified herein, shotcrete shall be maintained above 40°F (4°C) and in a moist condition.

1911.8.1 Initial curing: Shotcrete shall be kept continuously moist for 24 hours after shotcreting is completed or shall be sealed with an approved curing compound.

1911.8.2 Final curing: Final curing shall continue for seven days after shotcreting, or for three days if high-early-strength cement is used, or until the specified strength is obtained. Final curing shall consist of the initial curing process or the shotcrete shall be covered with an approved moisture-retaining cover.

1911.8.3 Natural curing: Natural curing shall not be used in lieu of that specified in this section unless the relative humidity remains at or above 85%, and is authorized by the *registered design professional*, and approved by the code official.

1911.9 Strength test: A strength test of shotcrete shall be made in accordance with the quality assurance provisions of ACI 506.2 listed in *Appendix A.*

780 CMR 1912.0 CONCRETE-FILLED PIPE COLUMNS

1912.1 General: Concrete-filled pipe columns shall be manufactured from standard, extra-strong or double-extra-strong steel pipe or tubing which is filled with concrete so placed and manipulated as to secure maximum density and to insure complete filling of the pipe without voids.

1912.2 Design: The safe supporting capacity of concrete-filled pipe columns shall be computed in accordance with the *approved rules* or as determined by a test.

1912.3 Connections: All caps, base plates and connections shall be of approved types and shall be positively attached to the shell and anchored to the concrete core. Welding of brackets without mechanical anchorage shall be prohibited. Where the pipe is slotted to accommodate webs of brackets or other connections, the integrity of the shell shall be restored by welding to insure hooping action of the composite section.

1912.4 Reinforcement: To increase the safe *load*-supporting capacity of concrete-filled pipe columns, the steel reinforcement shall be in the form of rods, structural shapes or pipe embedded in the concrete core with sufficient clearance to insure the composite action of the section, but not nearer than one inch (25 mm) to the exterior steel shell. All structural shapes used as reinforcement shall be milled to insure bearing on cap and base plates.

1912.5 Fireresistance rating protection: Pipe columns shall be of such size or so *protected* as to develop the required fireresistance ratings specified in Table 602. Where an outer steel shell is used to enclose the fireresistive covering, the shell shall not be included in the calculations for strength of the column section. The minimum diameter of pipe columns shall be four inches (102 mm) except that in structures of Type 5 construction not exceeding three stories or 40 feet (12192 mm) in *height*, pipe columns used in the basement and as secondary steel members shall have a minimum diameter of three inches (76 mm).

1912.6 Approvals: All details of column connections and splices shall be shop fabricated by approved methods and shall be approved only after tests in accordance with the *approved rules*. Shop-fabricated concrete-filled pipe columns shall be inspected by the code official or by an approved representative of the manufacturer at the plant.

NON-TEXT PAGE

CHAPTER 20

LIGHTWEIGHT METALS

780 CMR 2001.0 GENERAL

2001.1 Scope: The provisions of 780 CMR 20 shall govern the materials, design, construction and quality of aluminum and other lightweight metal alloys.

780 CMR 2002.0 MATERIALS

2002.1 General: Aluminum used for structural purposes in buildings and structures shall comply with AA SAS 30 and AA ASM 35 listed in ***Appendix A***. Other lightweight metal alloys used for structural purposes in buildings and structures shall be of approved materials.

NON-TEXT PAGE

CHAPTER 21

MASONRY

780 CMR 2101.0 GENERAL

2101.1 Scope: The provisions of 780 CMR 21 shall govern the materials, design, construction and quality of masonry.

2101.1.1 Engineered masonry design: All masonry shall conform to the engineered masonry design requirements of Chapters 1 through 8 of ACI 530/ASCE 5/TMS 402 listed in ***Appendix A***.

Exception: Where permitted by 780 CMR 2104.3, empirically designed masonry shall conform to 780 CMR 21 and Chapters 1 through 4 and Chapter 9 of ACI 530/ASCE 5/TMS 402 listed in ***Appendix A***.

2101.2 Seismic requirements: Masonry shall comply with the requirements of 780 CMR 2104.

780 CMR 2102.0 DEFINITIONS

2102.1 General: The following words and terms shall, for the purposes of 780 CMR 21 and as used elsewhere in 780 CMR, have the meanings shown herein.

Anchor: Metal rod, wire or strap that secures masonry to its structural support.

Architectural terra cotta: Plain or ornamental hard-burned plastic clay units, larger in size than brick, with glazed or unglazed ceramic finish.

Area, gross cross-sectional: The areas delineated by the out-to-out dimensions of masonry in the plane under consideration.

Bed joint: The horizontal layer of mortar on which a masonry unit is laid

Brick

Calcium silicate brick (sand lime brick): A building unit made of sand and lime.

Clay or shale: A solid masonry unit made of clay or shale, usually formed into a rectangular prism while in the plastic state and burned or fired in a kiln.

Concrete brick: A solid masonry unit having the approximate shape of a rectangular prism and composed of inert aggregate particles embedded in a hardened cementitious matrix.

Hollow brick: A masonry unit made of clay or shale whose net cross-sectional area in any plane parallel to the loadbearing surface is not less than 75% of its gross cross-sectional area measured in the same plane.

Buttress: A projecting part of a masonry wall built integrally therewith to furnish lateral stability which is supported on proper foundations.

Chimney: A primarily vertical enclosure containing one or more passageways.

Chimney, masonry: A field-constructed chimney of solid masonry units, stones or reinforced concrete (see 780 CMR 2114.0).

Collar joint: Vertical longitudinal joint between wythes of masonry or between masonry and back-up construction which is permitted to be filled with mortar or grout.

Connector: A mechanical device for securing two or more pieces, parts or members together, including anchors, wall ties and fasteners.

Diaphragm: A roof or floor system designed to transmit lateral forces to shear walls or other vertical resisting elements.

Dimensions, nominal: Equal to the actual dimension plus the width of the mortar joint. Dimensions and thicknesses specified in this chapter are nominal dimensions.

Effective height: Clear height of a braced member between lateral supports and used for calculating the slenderness ratio of a member. Effective height for unbraced members shall be calculated.

Head joint: Vertical mortar joint placed between masonry units within the wythe at the time the masonry units are laid.

Header (Bonder): A masonry unit that connects two or more adjacent wythes of masonry.

Height, walls: The vertical distance from the foundation wall or other immediate support of such wall to the top of the wall.

Masonry: A built-up construction or combination of building units or materials of clay, shale, concrete, glass, gypsum, stone or other approved units bonded together with mortar or monolithic concrete. Reinforced concrete is not classified as masonry.

Ashlar facing masonry: Facing of solid rectangular units larger in size than brick and made of burned clay or shale, natural or cast stone, with sawed, dressed and squared beds and mortar joints.

Ashlar masonry: Masonry composed of bonded, rectangular units, larger in size than brick, with sawed, dressed or squared beds and mortar joints.

Solid masonry: Masonry consisting of solid masonry units laid contiguously with the joints between the units filled with mortar, or consisting of plain concrete.

Masonry unit

Clay: A building unit larger in size than a brick, composed of burned clay, shale, fire clay or mixtures thereof.

Concrete: A building unit or block larger in size than 12 by 4 by 4 inches (305 mm by 102 mm by 102 mm) made of cement and suitable aggregates.

Hollow: A masonry unit whose net cross-sectional area in any plane parallel to the loadbearing surface is less than 75% of its gross cross-sectional area measured in the same plane.

Solid: A masonry unit whose net cross-sectional area in every plane parallel to the loadbearing surface is 75% or more of its gross cross-sectional area measured in the same plane.

Mortar: A plastic mixture of approved cementitious materials, fine aggregates and water used to bond masonry or other structural units (see 780 CMR 2105.0).

Mortar, surface-bonding: A mixture used to bond concrete masonry units which contains: hydraulic cement; glass fiber reinforcement with or without inorganic fillers or organic modifiers; and water (see 780 CMR 2105.8).

Rubble masonry: Masonry composed of roughly shaped stones.

Coursed rubble: Masonry composed of roughly shaped stones fitting approximately on level beds and well bonded. Random rubble: Masonry composed of roughly shaped stones laid without regularity of coursing but well bonded and fitted together to form well-defined joints.

Rough or ordinary rubble: Masonry composed of unsquared field stones laid without regularity of coursing but well bonded.

Running bond: The placement of masonry units such that head joints in successive courses are horizontally offset at least one-quarter the unit length.

Stack bond: The placement of masonry units in a bond pattern is such that head joints in successive courses are vertically aligned. For the purpose of this code, requirements for stack bond shall apply to all masonry laid in other than running bond.

Stone masonry: Masonry composed of field, quarried or caststone units bonded by mortar.

1. **Stone masonry, ashlar**: Stone masonry composed of rectangular units having sawed, dressed or squared bed surfaces and bonded by mortar.
2. **Stone masonry, rubble**: Stone masonry composed of irregular-shaped units bonded by mortar.

Tile, wall: Metal connector that connects wythes of masonry walls together.

Tile: A ceramic surface unit, usually relatively thin in relation to facial area, made from clay or a mixture of clay and other ceramic materials, called the body of the tile, having either a "glazed" or "unglazed" face and fired above red heat in the course of manufacture to a temperature sufficiently high enough to produce specific physical properties and characteristics (see 780 CMR 2105.0).

Tile, structural clay: A hollow masonry unit composed of burned clay, shale, fire clay or mixtures thereof, and having parallel cells (see 780 CMR 2105.0).

Wall

Cavity wall: A wall built of masonry units or of plain concrete, or a combination of these materials, arranged to provide an air space within the wall, and in which the inner and outer parts of the wall are tied together with metal ties.

Composite wall: A wall built of a combination of two or more masonry units of different materials bonded together, one forming the backup and the other the facing elements.

Dry-stacked, surface-bonded walls: A wall built of concrete masonry units where the units are stacked dry, without mortar on the bed or head joints, and where both sides of the wall are coated with a surface-bonding mortar (see 780 CMR 2106.3).

Faced wall: A wall in which the masonry facing and backing are so bonded as to exert common action under *load*.

Hollow wall: A wall built of masonry units so arranged as to provide an air space within the wall, and in which the facing and backing of the wall are bonded together with masonry units.

Parapet wall: That part of any wall entirely above the roof line.

Wythe: Each continuous, vertical section of a wall, one masonry unit in thickness.

780 CMR 2103.0 CONSTRUCTION DOCUMENTS

2103.1 Drawings: The drawings and details shall show all the items required to be shown on the drawings by 780 CMR including the following:

1. Specified size, grade, type and location of reinforcement, anchors and wall ties;
2. Reinforcing bars to be welded and welding procedure;
3. Size and location of all structural elements; and
4. Provision for dimensional changes resulting from elastic deformation, creep, shrinkage, temperature and moisture.

2103.2 Fireplace drawings: The *construction documents* shall describe in sufficient detail the location, size and construction of all masonry fireplaces. The thickness and characteristics of all material and the clearances from walls, partitions and ceilings shall be clearly indicated.

780 CMR 2104.0 SEISMIC REQUIREMENTS

2104.1 Scope: Seismic design requirements apply to the design of masonry and the construction of masonry building elements, except masonry veneers. Seismic requirements for masonry veneers shall comply with Chapter 12 of the ACI 530/ASCE 5/TMS 402 Masonry Code listed in *Appendix A*. All masonry shall be designed to comply with the requirements of Chapter 7 of the ACI 530/ ASCE 5/TMS 402 Masonry Code listed in *Appendix A*, except as otherwise permitted herein.

2104.2 General: Masonry structures and masonry elements shall comply with the requirements of 780 CMR 2104.3 through 2104.5. In addition, masonry structures and masonry elements shall comply with either the allowable stress design requirements of Section 5.1 of the ACI 530/ASCE 5/TMS 402 Masonry Code, listed in *Appendix A* and with 780 CMR 2104.2.2 and 2104.2.3, or the strength design requirements of 780 CMR 2104.2.1 and 780 CMR 2104.2.3.

2104.2.1 Strength requirements: For masonry structures that are not designed in accordance with Section 5.1 of the ACI 530/ASCE 5/TMS 402 Masonry Code listed in *Appendix A*, the provisions of 780 CMR 2104.0 shall apply. The design strength of masonry structures and masonry elements shall be at least equal to the required strength determined in accordance with this section except for masonry elements designed in accordance with the provisions of Chapter 9 of the ACI 530/ASCE 5/TMS 402 Masonry Code listed in *Appendix A*.

1. **Required strength**: Required strength, U, to resist seismic forces in such combinations with gravity and other loads including load factors shall be as required in 780 CMR 1616 except that non-bearing masonry walls shall be designed for the seismic force applied perpendicular to the plane of the wall and uniformly distributed over the wall area.
2. **Nominal strength**: The nominal strength of masonry shall be taken as 2½ times the allowable stress value. The allowable stress value shall be determined in accordance with Chapter 7 of the ACI 530/ASCE 5/TMS 402 Masonry Code listed in *Appendix A*.
3. **Design strength**: The design strength of masonry provided by a member, its connections to other members and its cross sections in terms of flexure, axial *load*, and shear shall be taken as the nominal strength multiplied by a strength reduction factor Φ, as follows;
   a. Axial load and flexure except for flexural tension in unreinforced masonry $\Phi = 0.8$.
   b. Flexural tension in unreinforced masonry $\Phi = 0.4$
   c. Shear $\Phi = 0.6$
   d. Shear and tension on anchor bolts embedded in masonry $\Phi = 0.6$

2104.2.2 Shear Factor: When calculating shear or diagonal tension stresses using allowable stress design, shear walls and beams which resist seismic forces shall be designed to resist 1.33 times the seismic shear forces obtained from an analysis of the building.

2104.2.3 Drift limits: The design story drift of masonry structures due to the combination of seismic forces and gravity loads shall not exceed 0.007 times the story height. The drift shall be calculated using load combinations 7 or 8 for strength design in 780 CMR 1616.3 1 with the seismic deflections multiplied by the seismic amplification factor, C_d, given in Table 1612.4.4.

2104.3 Design of elements that are not part of lateral force resisting system:

2104.3.1 Masonry elements that are listed in 780 CMR 2104.3 and isolated from the structure so that vertical and lateral forces are not imparted to these elements and that are not part of the lateral force resisting system shall comply with the provisions of 780 CMR 2104.3 and may be designed in accordance with the provisions of Chapter 9 of the ACI 530/ASCE 5/TMS 402 Masonry Code listed in *Appendix A*.

2104.3.2 *Load* bearing frames or columns that are not part of the lateral force resisting system shall be analyzed as to their effect on the response of the system. Such frames or columns shall be adequate for vertical *load* carrying capacity and induced moment due to the design story drift.

2104.3.3 Anchorage Of Masonry Walls: Masonry walls shall be anchored to the roof and all floors that provide lateral support out of plane for the wall. The anchorage shall provide a direct connection between the walls and the floor or roof construction. The connections shall be capable of resisting the greater of the seismic lateral force induced by the wall or 120 pounds per lineal foot of wall (allowable stress design), or 200 pounds per lineal foot of wall (strength design).

2104.3.4 Masonry partition walls 16 feet or less in height, masonry screen walls and other masonry elements, except those listed in 780 CMR 2104.3.6, that are not designed to resist vertical or lateral loads, other than those induced by their own mass, shall be isolated from the structure so that vertical and lateral forces are not imparted to these elements. Isolation joints and connectors between these elements and the structure shall be designed to accommodate the design story drift. Masonry elements listed in 780 CMR 2104.3.4 shall be reinforced in either the horizontal or vertical direction in accordance with the following;

1. **Horizontal reinforcement**: Horizontal reinforcement shall consist of at least two longitudinal W1.7 wires spaced not more than 16 in. (vertically) for walls greater than four inches in width and at least one longitudinal Wl.7 wire spaced not more than 16 inches for walls not exceeding four inches in width; or at least one No. 4 bar spaced not more than 48 inches Where two longitudinal wires of joint reinforcement are used, the space between these wires shall be the widest that the mortar joint will accommodate. Horizontal reinforcement shall be provided within 16 inches of the top and bottom of these masonry elements; OR
2. **Vertical reinforcement**: Vertical reinforcement shall consist of at least one No. 4 bar spaced not more than 48 inches Vertical reinforcement shall be located within 16 inches of the ends of masonry walls.

2104.3.5 Masonry partition walls, greater than 16 feet in height, masonry screen walls and other masonry elements except those listed in 780 CMR 2104.3.6, that are not designed to resist vertical or lateral loads, other than those induced by their own mass, shall be isolated from the structure so that the vertical and lateral forces are not imparted to these elements. Isolation joints and connectors between these elements and the structure shall be designed to accommodate the design story drift. Masonry elements listed in 780 CMR 2104.3.5 shall be reinforced in accordance with the following:

1. **Vertical reinforcement**: Vertical reinforcement of at least 0.2 square inches in cross-sectional area shall be provided at corners, within 16 inches of each side of openings, within eight inches of each side of movement joints, within eight inches of the ends of walls, and at a maximum spacing of eight feet.
2. **Horizontal reinforcement**: Horizontal reinforcement shall consist of at least two wires of W1.7 spaced not more than 16 inches. Horizontal reinforcement of at least 0.2 square inches in cross sectional areas shall also be provided at the bottom and top of wall openings and shall extend not less than 24 inches nor less than 40 bar diameters past the opening; continuously at structurally connected roof and floor levels; within 16 inches of the top of walls; and at a maximum spacing of eight feet.

2104.3.6 Nonstructural masonry partition walls that are isolated from the structure in accordance with 780 CMR 2104.3.4, and 2104.3.5, which enclose stairwells, exit discharges, exits and elevator shafts shall be designed for the code required lateral loads and at a minimum in accordance with the following:

1. **Vertical reinforcement**: Vertical reinforcement 0.31 square inches in cross sectional area shall be provided at corners, within 16 inches of each side of openings, within eitght inches of each side of movements joints, and within eight inches of the ends of walls and at a maximum spacing of six feet.
2. **Horizontal reinforcement**: Horizontal reinforcement shall consist of at least two wires of W1.7 spaced not more that 16 inches Horizontal reinforcement of at least 0.20 square inches in cross-sectional area shall also be provided at the bottom and top of wall openings and shall extend not less than 24 inches nor less than 40 bar diameters past the opening; continuously at structurally connected roof and floor levels; and within 16 inches of the top of walls; or
3. **Walls spanning horizontally**: Walls which are designed to span horizontally, shall comply with 780 CMR 2104.3.6 and the following: horizontal reinforcement shall consist of at least two wires of W.1.7 spaced not more than 16 inches. Horizontal reinforcement of at least 0.31 square inches in cross-sectional area shall also be provided at the bottom and top of wall openings and shall extend not less than 24 inches nor less than 40 bar diameters past the opening. Horizontal reinforcement of at least 0.31 square inches shall be provided continuously at structurally connected roof and floor levels, within 16 inches of the top of walls and at a maximum of six feet.

2104.3.7 Masonry walls listed in 780 CMR 2104.3, that are NOT isolated from the structure as required in 780 CMR 2104.3.4 and 2104.3.5, shall be designed to withstand the induced forces.

2104.4 Design of elements which are part of the lateral force resisting system, bearing walls, exterior walls, parapets and chimneys.

2104.4.1 Connections to masonry shear walls: Connectors shall he provided to transfer forces between horizontal elements and masonry walls in accordance with the requirements, of Section 5.11 of the ACI 530/ASCE 5/TMS 402 Masonry Code listed in *Appendix A*. Connectors shall be designed to transfer horizontal design forces acting either perpendicular or parallel to the wall, but not less than 200 pounds per lineal foot of wall (allowable stress design) or 335 pounds per lineal foot of wall (strength design). The maximum spacing between connectors shall be four feet.

2104.4.2 Connections to masonry columns: Connectors shall be provided to transfer forces between masonry columns and horizontal elements in accordance with the requirements of Section 5.11 of ACI 530/ASCE 5/TMS 402 Masonry Code listed in *Appendix A*. Where anchor bolts are used to connect horizontal elements to the tops of columns, anchor bolts shall be placed within lateral ties. Lateral tics shall enclose both the vertical bars in the column and the anchor bolts. There shall be a minimum of two No. 4 lateral ties provided in the top five inches of the column.

2104.4.3 Minimum reinforcement requirements for bearing walls, exterior walls, shear walls, parapets and chimneys: These walls shall be reinforced in both the vertical and horizontal direction. The sum of the cross-sectional area of horizontal and vertical reinforcement shall be at least 0.002 times the gross cross-sectional area of the wall, and the minimum cross-sectional area in each direction shall he not less than 0.0007 times the gross cross-sectional area of the wall. Reinforcement shall be uniformly distributed. The maximum spacing of reinforcement shall be 48 inches The maximum spacing of reinforcement for stack bond masonry shall be 24".

2104.4.4 Shear wall additional reinforcing requirements for buildings classified in Seismic Performance Category D: The maximum spacing of vertical and horizontal reinforcement shall be the smaller of; one-third the length of the shear wall, one-third the height of the shear wall, or 48 inches The minimum cross-sectional area of vertical reinforcement per horizontal foot of shear wall shall be one-third of the required shear reinforcement per vertical foot of shear wall. Shear reinforcing shall be anchored around vertical reinforcing bars with a standard hook.

2104.4.5 Minimum reinforcement for masonry columns: Lateral ties in masonry columns shall be spaced not more than eight inches on center and shall be at least ⅜ inches diameter. Lateral ties shall be embedded in grout.

2104.4.6 Material requirement: Neither Type N mortar nor masonry cement shall be used as part of the lateral force resisting system.

2104.4.7 Lateral tie anchorage: Standard hooks for lateral tie anchorage shall be either a 135 degree standard hook or a 180 degree standard hook.

2104.5 Inspection: Masonry shall be inspected in accordance with 780 CMR 1705.7.

780 CMR 2105.0 MASONRY CONSTRUCTION MATERIALS

2105.1 Concrete masonry units: Concrete masonry units shall conform to the following standards listed in *Appendix A*: ASTM C55 for concrete brick; ASTM C73 for calcium silicate face brick; ASTM C90 for loadbearing concrete masonry units; or ASTM C744 for prefaced concrete and calcium silicate masonry units.

2105.2 Clay or shale masonry units: Clay or shale masonry units shall conform to the following standards listed in *Appendix A*: ASTM C34 for structural clay loadbearing wall tile; ASTM C56 for structural clay nonloadbearing wall tile; ASTM C62 for building brick (solid masonry units made from clay or shale); ASTM C1088 for solid units of thin veneer brick; ASTM C126 for ceramic-glazed structural clay facing tile, facing brick and solid masonry units; ASTM C212 for structural clay facing tile; ASTM C216 for facing brick (solid masonry units made from clay or shale); and ASTM C652 for hollow brick (hollow masonry units made from clay or shale).

Exception: Structural clay tile for nonstructural use in fireproofing of structural members and in wall furring shall not be required to meet the compressive strength specifications. The fireresistance rating shall be determined in accordance with ASTM E119 listed in *Appendix A* and shall comply with the requirements of Table 602.

2105.3 Stone masonry units: Stone masonry units shall conform to the following standards listed in *Appendix A*: ASTM C503 for marble building stone (exterior); ASTM C568 for limestone building stone; ASTM C615 for granite building stone; ASTM C616 for sandstone building stone; or ASTM C629 for slate building stone.

2105.4 Ceramic tile: Ceramic tile shall be as defined in ANSI A137.1 listed in *Appendix A* and shall conform to the requirements of ANSI A137.1 listed in *Appendix A*.

2105.5 Glass block: Glass block shall be partially evacuated, hollow masonry units made of clear, colorless glass (with or without a highly reflective oxide surface coating), having a thickness of not less than 3⅛ inches or shall be solid glass-block units, having a thickness of not less than three inches.

2105.6 Second-hand units: Second-hand masonry units shall not be reused unless the units conform to the requirements for new units. The units shall be of whole, sound material and be free from cracks and other defects that will interfere with proper laying or use. All old mortar shall be cleaned from the units before reuse.

2105.7 Mortar: Mortar for masonry construction shall conform to ASTM C270 listed in *Appendix A*.

2105.8 Surface-bonding mortar: Surface-bonding mortar shall comply with ASTM C887 listed in *Appendix A*. Surface bonding of concrete masonry units shall comply with ASTM C946 listed in *Appendix A*.

2105.9 Metal reinforcement and accessories: Metal reinforcement and accessories shall conform to 780 CMR 2105.9.1 through 2105.9.7. Where unidentified reinforcement is approved for use, such reinforcement shall be tested in accordance with 780 CMR 2208.1.

2105.9.1 Deformed reinforcing bars: Deformed reinforcing bars shall conform to the following standards listed in *Appendix A*: ASTM A615 for deformed and plain billet-steel bars for concrete reinforcement; ASTM A616 for rail-steel deformed and plain bars for concrete reinforcement; ASTM A617 for axle-steel deformed and plain bars for concrete reinforcement; and ASTM A706 for low-alloy-steel deformed bars for concrete reinforcement.

2105.9.2 Joint reinforcement: Joint reinforcing wire shall conform to the following standards listed in *Appendix A*: ASTM A82 for steel wire, plain, for concrete reinforcement; and ASTM A167, Type 304, for stainless and heat-resisting chromium-nickel steel plate, sheet and strip.

Longitudinal wires shall be deformed. One set of two deformations shall occur around the perimeter of the wire at a maximum spacing of 0.7 times the diameter of the wire but not less than eight sets per one inch (25 mm) of length. The overall length of each deformation within the set shall be such that the summation of gaps between the ends of the deformations shall not exceed 33% of the perimeter of the wire. The indentation depth of the deformations shall be 0.006 inch (0.15 mm) plus or minus 0.003 inch (0.08 mm).

2105.9.3 Deformed reinforcing wire: Deformed reinforcing wire shall conform to ASTM A496 listed in *Appendix A*.

2105.9.4 Wire fabric: Wire fabric shall conform to ASTM A185 listed in *Appendix A* for plain steel-welded wire fabric for concrete reinforcement or ASTM A497 listed in *Appendix A* for welded deformed steel wire fabric for concrete reinforcement.

2105.9.5 Anchors, ties and accessories: Anchors, ties and accessories shall conform to the following standards listed in *Appendix A*: ASTM A36 for structural steel; ASTM A82 for plain steel wire for concrete reinforcement; ASTM A185 for plain steel-welded wire fabric for concrete reinforcement; ASTM A167, Type 304, for stainless and heat-resisting chromium-nickel steel plate, sheet and strip; and ASTM A366 for cold-rolled carbon steel sheet, commercial quality.

2105.9.6 Corrosion protection: Joint reinforcement anchors, wall ties and accessories, except those of Type 304 stainless steel complying with ASTM A 167 listed in *Appendix A*, shall be protected from corrosion by galvanizing as follows.

Metal accessories for use in exterior wall construction shall be hot-dipped galvanized after fabrication with a minimum coating of 1.5 ounces per square foot (458 g/m^2) in accordance with ASTM A153 listed in *Appendix A*. Metal accessories for use in interior wall construction shall be mill galvanized with a minimum coating of 0.1 ounce per square foot (31 g/m^2) in accordance with the standards listed in *Appendix A* as follows: ASTM A641 for joint reinforcement, wire anchors and ties; and ASTM A525, Class G-60, for sheet metal anchors and ties.

2105.9.7 Tests: Where unidentified reinforcement is approved for use, not less than three tension and three bending tests shall be made on representative specimens of the reinforcement from each shipment and grade of reinforcing steel proposed for use in the work.

2105.10 Mortars for ceramic wall and floor tile: Portland cement mortars for installing ceramic wall and floor tile shall comply with ANSI A108.1 listed in *Appendix A* and be of the compositions indicated in Table 2105.10.

2105.10.1 Dry-set portland cement mortars: Premixed prepared portland cement mortars, which require only the addition of water and which are used in the installation of ceramic tile, shall comply with ANSI A118.1 listed in *Appendix A* The shear bond strength for tile set in such mortar shall be as required in accordance with ANSI A118.1 listed in *Appendix A*. Tile set in dry-set portland cement mortar shall be installed in accordance with ANSI A108.5 listed in *Appendix A*.

2105.10.2 Electrically conductive dry-set mortars: Premixed prepared portland cement mortars, which require only the addition of water and which comply with ANSI A118.2 listed in *Appendix A*, shall be used in the installation of electrically conductive ceramic tile. Tile set in electrically conductive dry-set mortar shall be installed in accordance with ANSI A108.7 listed in *Appendix A*.

Table 2105.10

CERAMIC TILE MORTAR COMPOSITIONS

Walls	Scratchcoat	1 cement; 1/5 hydrated lime; 4 dry or 5 damp sand
	Setting bed and leveling coat	1 cement; ½ hydrated lime; 5 damp sand; to 1 cement; 1 hydrated lime; 7 damp sand
Floors	Setting bed	1 cement; 1/10 hydrated lime; 5 dry or 6 damp sand; or 1 cement; 5 dry or 6 damp sand
Ceilings	Scratchcoat and sand bed	1 cement;½ hydrated lime; 2½ dry sand or 3 damp sand

2105.10.3 Latex-modified portland cement mortars: Latex-modified portland cement thin-set mortars-in which latex is added to dry-set mortar as a replacement for all or part of the gauging water-which are used for the installation of ceramic tile shall comply with ANSI A118.4 listed in *Appendix A*. Tile set in latex-modified portland cement shall be installed in accordance with ANSI A108.5 listed in *Appendix A*.

2105.10.4 Epoxy mortar: Ceramic tile set and grouted with chemical-resistant epoxy shall comply with ANSI A118.3 listed in *Appendix A*. Tile set and grouted with epoxy shall be installed in accordance with ANSI A108.6 listed in *Appendix A*.

2105.10.5 Furan mortar and grout: Chemical-resistant furan mortar and grout which are used to install ceramic tile shall comply with ANSI A118.5 listed in *Appendix A*. Tile set and grouted with furan shall be installed in accordance with ANSI A108.8 listed in *Appendix A*.

2105.10.6 Modified epoxy-emulsion mortar and grout: Modified epoxy-emulsion mortar and grout which are used to install ceramic tile shall comply with ANSI A118.8 listed in *Appendix A*. Tile set and grouted with modified epoxy-emulsion mortar and grout shall be installed in accordance with ANSI A108.9 listed in *Appendix A*.

2105.10.7 Organic adhesives: Water-resistant organic adhesives used for the installation of ceramic tile shall comply with ANSI A136.1 listed in *Appendix A*. The shear bond strength after water immersion shall not be less than 40 psi (0.028 kg/mm^2) for Type I adhesive, and not less than 20 psi (0.014 kg/mm^2) for Type II adhesive, when tested in accordance with ANSI A136.1 listed in *Appendix A*. Tile set in organic adhesives shall be installed in accordance with ANSI A108.4 listed in *Appendix A*.

2105.10.8 Portland cement grouts: Portland cement grouts used for the installation of ceramic tile shall comply with ANSI A 118.6 listed in *Appendix A*. Portland cement grouts for tilework shall be installed in accordance with ANSI A108.10 listed in *Appendix A*.

2105.11 Grout: Grout shall conform to ASTM C476 listed in *Appendix A*.

780 CMR 2106.0 LATERAL STABILITY

2106.1 Shear walls: Where the structure depends upon masonry walls for lateral stability, shear walls shall be provided parallel to the direction of the lateral forces resisted.

2106.1.1 Shear wall thickness: Minimum nominal thickness of masonry shear walls shall be eight inches.

Exception: Shear walls of one-story buildings are permitted to be a minimum nominal thickness of six inches.

2106.1.2 Cumulative length of shear walls: In each direction in which shear walls are required for lateral stability, the minimum cumulative length of shear walls provided shall be 0.4 times the long dimension of the building. Cumulative length of shear walls shall not include openings.

2106.1.3 Maximum diaphragm ratio: Masonry shear walls shall be provided so that the span-to-width (or depth) ratio of floor or roof diaphragms does not exceed that indicated in Table 2106.1.3.

Table 2106.1.3

MAXIMUM SPAN-TO-WIDTH (DEPTH) RATIO OF FLOOR AND ROOF DIAPHRAGMS

Floor or roof diaphragm construction	Maximum span-to-width (depth) ratio of Diaphragm
Cast-in-place concrete	5:1
Precast concrete	4:1
Metal deck with concrete fill	3:1
Metal deck without fill	2:1
Wood diaphragm	2:1

2106.2 Roofs: The roof construction shall be designed so as not to impart out-of-plane lateral thrust to the walls under roof gravity *load*.

2106.3 Surface-bonded walls: Dry-stacked, surface-bonded concrete masonry walls shall comply with the requirements of 780 CMR for masonry wall construction, except where otherwise noted in 780 CMR 2106.

2106.3.1 Strength: Dry-stacked, surface-bonded concrete masonry walls shall be of adequate strength and proportions to support all superimposed *loads* without exceeding the allowable stresses listed in Table 2106.3.1. Allowable stresses not specified in Table 2106.3.1 shall comply with the requirements of ACI 530/ASCE 5/TMS 402 listed in ***Appendix A***.

Table 2106.3.1

ALLOWABLE STRESS GROSS CROSS-SECTIONAL AREA FOR DRY-STACKED, SURFACE-BONDED CONCRETE MASONRY WALLS

Compression	
standard block	45 psi
Shear	10 psi
Flexural tension	
Vertical span	18 psi
Horizontal span	30 psi

2106.4 Construction: Construction of dry-stacked, surface-bonded masonry walls, including stacking and leveling of units, mixing and application of mortar, and curing and protection, shall comply with ASTM C946 listed in ***Appendix A***.

780 CMR 2107.0 COMPRESSIVE STRESS REQUIREMENTS

2107.1 Vertical dead plus live loads: Compressive stresses in masonry due to vertical *dead* plus *live loads* (excluding *wind* or seismic *loads*) shall be determined in accordance with 780 CMR 2107.2.1. *Dead* and *live loads* shall be in accordance with 780 CMR 16, with such *live load* reductions as are permitted in 780 CMR 1608.0.

2107.2 Maximum values: The compressive stresses in masonry shall not exceed the values given in Table 2107.2. Stress shall be calculated based on actual rather than nominal dimensions.

2107.2.1 Calculated compressive stresses: Calculated compressive stresses for single-wythe walls and for multiple-wythe composite masonry walls shall be determined by dividing the design *load* by the gross cross-sectional area of the member. The area of openings, chases or recesses in walls shall not be included in the gross cross-sectional area of the wall.

2107.2.2 Multiple-wythe walls: The allowable stress shall be as given in Table 2107.2 for the weakest combination of the units and mortar used in each wythe.

Table 2107.2

ALLOWABLE COMPRESSIVE STRESSES FOR EMPIRICAL DESIGN OF MASONRY

Construction; compressive strength of unit, gross area, psi	Allowable compressive stresses[a] gross cross-sectional area, psi	
	Type M or S mortar	Type N mortar
Solid masonry of brick and other solid units of clay or shale; sand-lime or concrete brick:		
8,000 or greater	350	300
4,500	225	200
2,500	160	140
1,500	115	100
Grouted masonry of clay or shale, sand-lime or concrete:		
4,500 or greater	225	200
2,500	160	140
1,500	115	100
Solid masonry of solid concrete masonry units:		
3.000 or greater	225	200
2,000	160	140
1.200	115	100
Masonry of hollow loadbearing units:		
2,000 or greater	140	120
1,500	115	100
1,000	75	70
750	60	55
Hollow walls (noncomposite masonry bonded[b])		
Solid units:		
2,500 or greater	160	140
1,500	115	100
Hollow units	75	70
Stone ashlar masonry:		
Granite	720	640
Limestone or marble	450	400
Sandstone or cast stone	360	320
Rubble stone masonry		
Coursed, rough or random	120	100

Note a. Linear interpolation for determining allowable stresses for masonry units having compressive strengths which are intermediate between those given in the table is permitted.

Note b. Where floor and roof loads are carried upon one wythe, the gross cross-sectional area is that of the wythe under load; if both wythes are loaded, the gross cross-sectional area is that of the wall minus the area of the cavity between the wythes. Walls bonded with metal ties shall be considered as noncomposite walls unless collar joints are filled with mortar or grout.

780 CMR 2108.0 LATERAL SUPPORT

2108.1 General: Masonry walls shall be laterally supported in either the horizontal or the vertical direction at intervals not exceeding those given in Table 2108.1.

2108.1.1 Thickness: Except for cavity walls and cantilever walls, the thickness of a wall shall be the nominal thickness measured perpendicular to the face of the wall. For cavity walls, the thickness shall be determined as the sum of the nominal thicknesses of the individual wythes. For cantilever walls, except for parapets, the ratio of height to nominal thickness shall not exceed 6:1 for solid masonry or 4:1 for hollow masonry. The thickness and height of parapets shall conform to 780 CMR 2109.2.

2108.2 Lateral support: Lateral support shall be provided by cross walls, pilasters, buttresses or structural frame members where the limiting distance is taken horizontally, or by floors, or roofs acting as diaphragms or structural frame members where the limiting distance is taken vertically.

Table 2108.1
WALL LATERAL SUPPORT REQUIREMENTS

Construction	Maximum ratio of wall length to thickness or wall height to thickness
Loadbearing walls	
Solid or solid grouted	20
All other	18
Nonloadbearing walls	
Exterior	18
interior	36

780 CMR 2109.0 THICKNESS OF MASONRY

2109.1 Thickness of walls: The nominal thickness of masonry walls shall conform to the requirements of 780 CMR 2109.

2109.1.1 Minimum thickness: The minimum thickness of masonry loadbearing walls more than one story high shall be eight inches. The minimum thickness of masonry loadbearing walls of one-story buildings shall not be less than six inches.

2109.1.2 Rubble stone walls: The minimum thickness of rough or random or coursed rubble stone walls shall be 16 inches.

2109.1.3 Change in thickness: Where a wall of masonry of hollow units or a masonry-bonded hollow wall is decreased in thickness, a course or courses of solid masonry shall be interposed between the wall below and the thinner wall above, or special units or construction shall be used to transmit the *loads* from face shells or wythes above to those below.

2109.2 Parapet walls: Parapet walls shall be at least eight inches thick, and the height shall not exceed three times the thickness. Parapet walls shall be reinforced in accordance with 780 CMR 2104.4.3.

780 CMR 2110.0 BOND

2110.1 General: The facing and backing of multiple-wythe masonry walls shall be bonded in accordance with 780 CMR 2110.2, 2110.3 or 2110.4.

2110.2 Bonding with masonry headers: Bonding with solid or hollow masonry headers shall comply with 780 CMR 2110.2.1 and 2110.2.2.

2110.2.1 Solid units: Where the facing and backing (adjacent wythes) of solid masonry construction are bonded by means of masonry headers, not less than 4% of the wall surface of each face shall be composed of headers extending not less than three inches (76 mm) into the backing. The distance between adjacent full-length headers shall not exceed 24 inches (610 mm) either vertically or horizontally. In walls in which a single header does not extend through the wall, headers from the opposite sides shall overlap at least three inches (76 mm), or headers from opposite sides shall be covered with another header course overlapping the header below at least three inches (76 mm).

2110.2.2 Hollow units: Where two or more hollow units are used to make up the thickness of a wall, the stretcher courses shall be bonded at vertical intervals not exceeding 34 inches (864 mm) by lapping at least three inches (76 mm) over the unit below, or by lapping at vertical intervals not exceeding 17 inches (432 mm) with units which are at least 50% greater in thickness than the units below.

2110.3 Bonding with wall ties or joint reinforcement: Bonding with wall ties or joint reinforcement shall comply with 780 CMR 2110.3.1 through 2110.3.2.

2110.3.1 Bonding with wall ties: Except as required by 780 CMR 2110.3.1.1, where the facing and backing (adjacent wythes) of masonry walls are bonded with 3/16-inch diameter wall ties or metal wire of equivalent stiffness embedded in the horizontal mortar joints, there shall be at least one metal tie for each 4½ square feet (0.42 m^2) of wall area. Ties in alternate courses shall be staggered. The maximum vertical distance between ties shall not exceed 24 inches (610 mm), and the maximum horizontal distance shall not exceed 36 inches (914 mm). Rods or ties bent to rectangular shape shall be used with hollow masonry units laid with the cells vertical. In other walls, the ends of ties shall be bent to 90-degree (1.57 rad) angles to provide hooks not less than two inches (51 mm) long. Additional bonding ties shall be provided at all openings, spaced not more than three feet (914 mm) apart around the perimeter and within 12 inches (305 mm) of the opening.

2110.3.1.1 Bonding with adjustable wall ties: Where the facing and backing (adjacent wythes) of masonry are bonded with adjustable wall ties, there shall be at least one tie for each 1.77 square feet (0.16 m^2) of wall area. Neither the vertical nor horizontal spacing of the adjustable wall ties shall exceed 16 inches (406 mm). The maximum vertical offset of bed joints from one wythe to the other shall be 1¼ inches (32 mm). The maximum clearance between connecting parts of the ties shall be 1/16 inch (1.6 mm). Where pintle legs are used, ties shall have at least two 3/16-inch (5 mm) diameter legs.

2110.3.2 Bonding with prefabricated joint reinforcement: Where the facing and backing (adjacent wythes) of masonry are bonded with prefabricated joint reinforcement, there shall be at least one cross wire serving as a tie for each 2⅔ square feet (0.25 m^2) of wall area. The vertical spacing of the joint reinforcement shall not exceed 16 inches (406 mm). Cross wires on prefabricated joint reinforcement shall not be smaller than No. 9 gage. The longitudinal wires shall be embedded in the mortar.

2110.4 Bonding with natural or cast stone: Bonding with natural or cast stone shall conform to 780 CMR 2110.4.1 and 2110.4.2.

2110.4.1 Ashlar masonry: In ashlar masonry, uniformly distributed bonder units shall be provided to the extent of not less than 10% of the wall area. Such bonder units shall extend not less than four inches (102 mm) into the backing wall.

2110.4.2 Rubble stone masonry: Rubble stone masonry 24 inches or less in thickness shall have bonder units with a maximum spacing of 3 feet (914 mm) vertically and three feet (914 mm) horizontally. Rubble stone masonry greater than 24 inches in thickness shall have one bonder unit for each six square feet (0.56 m^2) of wall surface on both sides.

2110.5 Masonry bonding pattern: Masonry laid in running and stack bond shall conform to 780 CMR 2110.5.1 and 2110.5.2.

2110.5.1 Masonry laid in running bond: In each wythe of masonry laid in running bond, head joints in successive courses shall be offset by not less than one-fourth the unit length, or the masonry walls shall be reinforced longitudinally as required in 780 CMR 2110.5.2.

2110.5.2 Masonry laid in stack bond: Where unit masonry is laid with less head joint offset than in 780 CMR 2110.5.1, the minimum area of horizontal reinforcement placed in mortar bed joints or in bond beams spaced not more than 48 inches (1219 mm) apart shall be 0.0007 times the vertical cross-sectional area of the wall.

780 CMR 2111.0 ANCHORAGE

2111.1 General: Masonry elements shall be anchored in accordance with 780 CMR 2111.0.

2111.2 Intersecting walls: Masonry walls depending upon one another for lateral support shall be anchored or bonded at locations where the walls meet or intersect by one of the following methods indicated in 780 CMR 2111.2.1 through 2111.2.5.

2111.2.1 Bonding pattern: 50% of the units at the intersection shall be laid in an overlapping masonry bonding pattern, with alternate units having a bearing of not less than three inches (76 mm) on the unit below.

2111.2.2 Steel connectors: Walls shall be anchored by steel connectors having a minimum cross section of ¼-inch by 1½ inches with ends bent up at least two inches (51 mm), or with cross pins to form anchorage. Such anchors shall be at least 24 inches (610 mm) long and the maximum spacing shall be four feet (1219 mm).

2111.2.3 Joint reinforcement: Walls shall be anchored by joint reinforcement spaced at a maximum distance of eight inches (203 mm). Longitudinal reinforcement shall be at least No. 9 gage and shall extend at least 30 inches (762 mm) in each direction at the intersection.

2111.2.4 Interior nonloadbearing walls: Interior nonloadbearing walls shall be anchored at the intersection of the walls at vertical intervals of not more than 16 inches (406 mm) with joint reinforcement or ¼-inch galvanized mesh hardware cloth.

2111.2.5 Ties, joint reinforcement and anchors. Other metal ties, joint reinforcement or anchors, if used, shall-be spaced to provide equivalent area of anchorage to that required by 780 CMR 2111.0.

2111.3 Floor and roof anchorage: Floor and roof diaphragms providing lateral support to masonry shall comply with 780 CMR 1612.4.7.1.2 and shall be connected to the masonry by one of the methods specified in 780 CMR 2111.3.1 through 2111.3.3.

2111.3.1 Wood floor joists: Wood floor joists supported by masonry walls shall be anchored to the wall at intervals not to exceed six feet (1829 mm) by metal strap anchors. Joists parallel to the wall shall be anchored with metal straps spaced not more than six feet (1829 mm) on centers extending over or under and secured to at least three joists. Blocking shall be provided between joists at each strap anchor.

2111.3.2 Steel floor joists: Steel floor joists shall be anchored to masonry walls with ⅜-inch round bars, or their equivalent, spaced not more than six feet (1829 mm) on center. Where joists are parallel to the wall, anchors shall be located at joist cross bridging.

2111.3.3 Roof structures: Roof structures shall be anchored to masonry walls with ½-inch bolts six feet (1829 mm) on center. Bolts shall extend and be embedded at least 15 inches (381 mm) into the masonry, or be hooked or welded to not less than 0.2 square inches (129 mm^2) of bond beam reinforcement placed not less than six inches (152 mm) from the top of the wall.

2111.4 Walls adjoining structural framing: Walls that are dependent upon the structural frame for lateral support shall be anchored to the structural members with metal anchors or otherwise keyed to the structural members. Metal anchors shall consist of ½-inch bolts spaced at four feet (1219 mm) on center embedded four inches (102 mm) into the masonry, or of other bolts of equivalent area.

780 CMR 2112.0 MASONRY CONSTRUCTION

2112.1 Masonry construction: Masonry construction shall comply with the requirements of 780 CMR 2112.1.1 through 2112.5.

2112.1.1 Tolerances: Masonry shall be constructed within the tolerances specified in ACI 530.1/ASCE 6/TMS 602 listed in ***Appendix A***.

2112.1.2 Placing mortar and units: Placement of mortar and units shall comply with 780 CMR 2112.1.2.1 through 2112.1.2.4.

2112.1.2.1 Bed and head joints: Unless otherwise required or indicated on the project drawings, head and bed joints shall be ⅜ inch (10 mm) thick, except that the thickness of the bed joint of the starting course placed over foundations shall not be less than ¼-inch (6 mm) and not more than ¾-inch (19 mm).

2112.1.2.2 Hollow units: Hollow units shall be placed such that face shells of bed joints are fully mortared, webs are fully mortared in all courses of piers, column and pilasters, in the starting course on foundations, where adjacent cells or cavities are to be grouted and where otherwise required, and head joints are mortared a minimum distance from each face equal to the face shell thickness of the unit.

2112.1.2.3 Solid units: Unless otherwise required or indicated on the project drawings, solid units shall be placed in fully mortared bed and head joints. The ends of the units shall be completely buttered. Head joints shall not be filled by slushing with mortar. Head joints shall be constructed by shoving mortar tight against the adjoining unit. Bed joints shall not be furrowed deep enough to produce voids.

2112.1.2.4 All units: Units shall be placed while the mortar is soft and plastic. Any unit disturbed to the extent that the initial bond is broken after initial positioning shall he removed andrelaid in fresh mortar.

2112.1.3 Installation of wall ties: The ends of wall ties shall be embedded in mortar joints. Wall tie ends shall engage outer face shells of hollow units by at least ½-inch (13 mm). Wire wall ties shall be embedded at least 1½ inches (38 mm) into the mortar bed of solid masonry units or solid-grouted hollow units. Wall ties shall not be bent after being embedded in grout or mortar.

2112.1.4 Chases: Chases shall be constructed as masonry units are laid.

2112.1.5 Bracing of masonry: Bracing that will assure stability of masonry during construction shall be provided and installed.

2112.1.6 Construction loads: Construction *loads* shall not exceed the superimposed *loads* that the masonry, with supplemental supports, is capable of supporting safely.

2112.1.7 Masonry protection: The top of unfinished masonry work shall be covered to protect the masonry from the weather

2112.2 Corbeled masonry: Solid masonry units shall be used for corbeling. The maximum corbeled projection beyond the face of the wall shall not be more than ½ of the wall thickness nor ½ the wythe thickness for hollow walls. The maximum projection of one unit shall neither exceed ½ the height of the unit nor ⅓ the thickness at right angles to the wall.

2112.2.1 Molded cornices: Unless structural support and anchorage are provided to resist the overturning moment, the center of gravity of all projecting masonry or molded cornices shall lie within the middle one-third of the supporting wall. Terra cotta and metal cornices shall be provided with a structural frame of approved noncombustible material anchored in an approved manner.

2112.3 Cold-weather construction: The following cold-weather procedures shall be implemented when either the ambient temperature falls below 40°F (4°C) or the temperature of masonry units is below 40°F (4°C):

1. Temperatures of masonry units shall not be less than 20°F (-7°C) when laid in the masonry. Visible ice on masonry units shall be removed before the unit is laid in the masonry.
2. Mortar sand or mixing water shall be heated to produce mortar temperatures between 40°F (4°C) and 120°F (49°C) at the time of mixing. Mortar

shall be maintained above freezing until used in masonry.

3. Heat sources shall be used where ambient temperatures are between 20°F (-7°C) and 25°F (-4°C) on both sides of the masonry under construction and wind breaks shall be installed when wind velocity is in excess of 15 mph (6.7 m/s).

4. Where ambient temperatures are below 20°F (-7°C), an enclosure for the masonry under construction shall be provided and heat sources shall be used to maintain temperatures above 32°F (0°C) within the enclosure.

5. Where mean daily temperatures are between 32°F (0°C), and 40°F (4°C), completed masonry shall be protected from rain or snow by covering with a weather-resistant membrane for 24 hours after construction.

6. Where mean daily temperatures are between 25°F (-4°C) and 32°F (0°C), completed masonry shall be completely covered with a weather-resistant membrane for 24 hours after construction.

7. Where mean daily temperatures are between 20°F (-7°C) and 25°F (-4°C), completed masonry shall be completely covered with insulating blankets or equal protection for 24 hours after construction.

8. Where mean daily temperatures are below 20°F (-7°C), masonry temperature shall be maintained above 32°F (0°C) for 24 hours after construction by enclosure with supplementary heat, by electric heating blankets, by infrared heat lamps or by other approved methods.

2112.4 Hot-weather construction: The following hot-weather procedures shall be implemented when either of the following conditions exist: the ambient temperature equals or exceeds 100°F (38°C) or the ambient temperature equals or exceeds 90°F (32°C) with a wind velocity greater than eight mph (3.6 m/s).

1. Mortar beds shall not be spread more than four feet (1219 mm) ahead of masonry.

2. Masonry units shall be laid within one minute after mortar placement.

2112.5 Wetting of brick: Brick (clay or shale) at the time of laying shall require wetting if the unit's initial rate of water absorption exceeds 30 grams per 30 square inches per minute (30 g/323 mm^2) or 0.035 ounces per square inch (0.0015 g/mm^2), as determined by ASTM C67 listed in *Appendix A*.

780 CMR 2113.0 MISCELLANEOUS REQUIREMENTS

2113.1 Chases and recesses: Masonry directly above chases or recesses wider than 12 inches (305 mm) shall be supported on lintels.

2113.2 Lintels: The design for lintels shall be in accordance with the engineered masonry design provisions of 780 CMR 2101.1.1. Minimum length of end support shall be four inches (102 mm).

2113.3 Support on wood: Masonry shall not be supported on wood girders or other form of wood construction.

Exception: Glass-block panels complying with 780 CMR 2115.0 are permitted to be supported by wood members.

780 CMR 2114.0 FIREPLACES AND CHIMNEYS

2114.1 Scope: The provisions of 780 CMR 2114.0 shall govern the design, installation, maintenance, repair and approval of all masonry fireplaces and chimneys.

2114.2 Mechanical code: All masonry fireplaces and chimneys shall conform to the applicable requirements of the BOCA national mechanical code listed in *Appendix A*.

2114.3 Dimensions: The firebox of a masonry fireplace shall have a minimum depth of 20 inches (508 mm). The size of the chimney connection shall have a minimum cross-sectional area of 50 square inches (32258 mm^2). The minimum cross-sectional area of the fireplace shall equal the cross-sectional area of the chimney connection.

2114.3.1 Rumford fireplaces: Rumford fireplaces shall be permitted provided that the depth of the fireplace is at least 12 inches (305 mm) and is at least ⅓ of the width of the fireplace opening; and that the throat is at least 12 inches (305 mm) above the lintel, and is at least 1/20th of the cross-sectional area of the fireplace opening.

2114.4 Wall construction: Fireplace walls lined with a minimum of two inches (51 mm) of approved low-duty refractory brick shall have a minimum total thickness of eight inches (203 mm) of solid masonry. Approved medium-duty fire-clay mortar or an equivalent shall be utilized with the low-duty refractory brick. Unlined fireplace walls shall be constructed of solid masonry having a minimum total thickness of 12 inches (305 mm).

2114.4.1 Extension of liners: The liner of the fireplace walls shall extend a minimum of four inches (102 mm) into the throat of the fireplace.

2114.4.2 Throat and smoke chamber: The walls of the throat and smoke chamber shall be constructed of solid masonry having a minimum thickness of eight inches (203 mm). The throat and smoke chamber walls are permitted to be reduced in thickness to four inches (102 mm) of solid masonry provided that such walls are lined with at least one inch (25 mm) of insulating refractory masonry so that the heat transferred through this wall is not more than the heat transferred through eight inches (203 mm) of solid masonry.

2114.4.3 Heat exchanger: Gravity-fed heat exchangers installed in the walls of masonry fireplaces shall not reduce the total thickness of solid masonry.

2114.5 Foundation and hearth: The foundation of a fireplace shall be constructed of noncombustible materials and shall conform to the requirements of 780 CMR 18. The hearth and hearth extension shall be constructed of solid masonry having a minimum thickness of four inches (102 mm).

2114.5.1 Hearth extension: The hearth shall extend a minimum of 16 inches (406 mm) beyond the face of the fireplace opening and a minimum of eight inches (203 mm) on each side of the fireplace opening for fireplaces having an opening of less than six square feet (0.56 m^2). The hearth of larger-sized fireplaces shall extend a minimum of 20 inches (508 mm) beyond the face of the fireplace opening and a minimum of 12 inches (305 mm) on each side of the fireplace opening. Combustible forms used during construction of the hearth and hearth extension shall be removed.

2114.6 Clearance to combustibles (also see 780 CMR 3610 as applicable):

1. Fireplaces - the exterior surface of fireplace walls shall have a minimum of four inches (102mm) clearance to combustibles.
2. Fireplaces - combustible materials attached to a fireplace face, such as trim and mantels, shall have a minimum clearance of six inches (152 mm) from a fireplace opening.
3. Fireplaces - combustible materials above and projecting more than 1½ inches (38mm) from a fireplace face shall have a minimum clearance of 12 inches (305mm) above a fireplace opening.
4. Chimneys - combustible materials, including framing and sheathing shall have a minimum clearance of two inches (51mm) from the exterior surface of smoke chamber walls and chimney walls.

2114.7 Opening to the chimney: Means shall be provided to shut off the opening to the chimney when the fireplace is not in operation.

2114.7.1 Dampers: Dampers shall be constructed of metal having a minimum thickness of No. 12 Manufacturer's Standard Gage (0.105 inch).

2114.8 Chimneys with metal hoods: Metal hoods shall extend a minimum of six inches (152 mm) beyond the firebox. The hoods shall comply with the requirements for metal chimneys.

2114.9 Existing masonry chimneys: Existing masonry chimneys are permitted to vent open fireplaces only-even if the existing chimneys lack the clearances to combustibles as required by the BOCA national mechanical code listed in ***Appendix A*** - provided that such chimneys otherwise conform to the requirements of the BOCA national mechanical code listed in ***Appendix A*** or are made to conform to such requirements through repair or relining.

780 CMR 2115.0 GLASS-BLOCK WALLS

2115.1 General: Masonry of glass blocks used in nonloadbearing exterior or interior walls and in window openings, either isolated or in continuous bands, shall have a minimum thickness of three inches at the mortar joint and all the mortared surfaces of the glass block shall be treated for mortar bonding. Sizes of structural members supporting glass-block panels shall be determined by structural analysis to avoid excessive or harmful deflection. Maximum deflection of such members shall not exceed 1/600 of the span of the supporting members.

Solid or hollow approved glass blocks shall not be used in *fire walls*, party walls, *fire separation assemblies* or *fire partitions*, or for loadbearing construction. Such blocks shall be erected with mortar and reinforcement in metal-channel-type frames, structural frames, masonry or concrete recesses or embedded panel anchors as provided for both exterior and interior walls or other approved joint materials. Wood strip framing shall not be used in *fire separation assemblies* that are required to be fireresistance rated.

Exceptions:

1. Glass-block assemblies having a fireresistance rating of not less than ¾ hour shall be permitted as opening protectives in *fire separation assemblies* or in *fire partitions* which have a required fireresistance rating of 1 hour or less and do not enclose *exit stairways* or *exit* passageways.
2. Glass-block assemblies as permitted in 780 CMR 404.5, Exception 2.

2115.2 Size of panels: The maximum dimensions of all hollow glass-block wall panels in both exterior and interior walls, where used singly or in multiples to form continuous bands of glass blocks between structural supports, shall be 25 feet (7620 mm) in length and 20 feet (6096 mm) in height between structural supports and expansion joints; and the area of each individual panel shall not be more than 144 square feet (13.39 m^2) for exterior panels and 250 square feet (23.25 m^2) for interior panels. Intermediate structural supports shall be provided to support the *dead load* of the wall and all other superimposed *loads*. Where individual panels are more than the maximum area permitted for those panels, a supplementary structural stiffener shall be provided to anchor the panels to the structural supports.

The maximum area of all solid glass-block wall panels in both exterior and interior walls shall not be more than 100 square feet (9.3 m^2).

2115.3 Joint materials: Glass block shall be laid up in Type S or N mortar. Both vertical and horizontal mortar joints shall be at least ¼ inch (6 mm) and not more than ½ inch (13 mm) thick and shall be completely filled. The sills of glass-block panels shall be coated with approved water-based asphaltic emulsion, or other elastic waterproofing material, prior to laying the first mortar course. All individually framed glass-block panels shall be provided with ⅜-inch-thick (10 mm) expansion joints at the sides and top. Expansion joints shall be entirely free of mortar and shall be caulked to a depth of not less than ½ inch (13 mm) with nonhardening caulking compound on both faces, or other approved expansion joints shall be provided.

2115.4 Reinforcement: Glass-block panels shall have joint reinforcement in every other mortar bed joint, extending the entire length of the panel, but not across expansion joints. Joint reinforcement is permitted to be spliced by lapping longitudinal wires at least six inches (152 mm). Joint reinforcement shall be placed in the bed joint immediately below and above any opening in the panel. Joint reinforcement shall be hot-dipped galvanized after fabrication.

2115.5 Wind and earthquake loads: Exterior wall panels shall be held in place in the wall opening to resist both the internal and external pressures due to *wind* and *earthquake loads* as specified in 780 CMR 1611.0 and 1612.0, with metal-channel-type frames, structural frames, masonry or concrete recesses or embedded panel anchors at the sides and top. Where recess type of framing is used, glass block shall be recessed within the framing not less than one inch (25 mm).

CHAPTER 22

STEEL

780 CMR 2201.0 GENERAL

2201.1 Scope: The provisions of 780 CMR 22 shall govern the materials, design, construction and quality of structural steel members.

780 CMR 2202.0 DEFINITIONS

2202.1 General: The following words and terms shall, for the purposes of 780 CMR 22 and as used elsewhere in 780 CMR, have the meanings shown herein.

Steel construction, cold-formed: That type of construction made up entirely, or in part, of steel structural members cold formed to shape from sheet or strip steel such as roof deck, floor and wall panels, studs, floor joists, roof joists and other structural elements.

Steel joist: Any steel structural member of a building or structure made of hot-rolled or cold-formed solid or open-web sections, or riveted or welded bars, strip or sheet steel members, or slotted and expanded, or otherwise deformed rolled sections

Steel member, structural: Any steel structural member of a building or structure consisting of a rolled steel structural shape other than cold-formed steel, light-gage steel or steel joist members.

780 CMR 2203.0 STRUCTURAL STEEL CONSTRUCTION

2203.1 General: Structural steel construction used in all buildings and structures shall be fabricated from materials of uniform quality which are free from defects that vitiate the strength or stability of the structure. All structural steel shall be designed and constructed in accordance with either the AISC *Specification for Structural Steel Buildings-Allowable Stress Design and Plastic Design*, hereafter referred to AISC ASD, or the AISC *Load and Resistance Factor Design Specification for Structural Steel Buildings*, hereafter referred to as AISC LRFD, listed in ***Appendix A***, except as modified by the provisions of 780 CMR 2204.0.

2203.2 Structural steel seismic requirements: The design of structural steel members and connections to resist seismic forces shall be in accordance with 780 CMR 2203.1 and the AISC *Seismic Provisions for Structural Steel Buildings*, listed in *Appendix A*, except as modified by 780 CMR 2203.2.1 and 780 CMR 1616.

2203.2.1 Modifications to AISC seismic provisions: The AISC *Seismic Provisions for Structural Steel Buildings* shall be modified as indicated in items 1 through 8.

1. In Part 1, Section 2.1 of the AISC Provisions, replace the entire paragraph with the following: "All buildings assigned to Category C shall be designed in accordance with these provisions".

2. 780 CMR Table 1612.2.5 shall be used in lieu of Table 2-1 in Part I of the AISC Provisions.

3. In Part 1, Section 3.1, of the AISC Provisions, delete the entire section, except for Load Combinations 3-7 and 3-8 and replace with 780 CMR 1616.3. Replace load combinations 3-7 and 3-8 as follows;

$$1.3\ \text{Dead}+1.0\ \text{Floor Live}+0.7\ \text{Snow} +/-(2R/5)\ \text{Seismic} \qquad (3\text{-}7)$$

$$(0.9 - 0.5\ A_v)\text{Dead} +/- (2R/5)\ \text{Seismic} \qquad (3\text{-}8)$$

The term (2R/5) shall be greater than or equal to 1.0

4. In Part I, Section 6.1, of the AISC Provisions, replace equation 6-1 with the following:

$$1.3\ \text{Dead}+1.0\ \text{Live}+0.7\ \text{Snow}+(2R/5)\ \text{Seismic} \leq \Phi_c P_n \qquad (6\text{-}1)$$

5. In Part I, Section 6.1, of the AISC Provisions, replace equation 6-2 with the following:

$$(0.9 - 0.5A_v)\ \text{Dead} - (2R/5)\text{Seismic} \leq \Phi_t P_n \qquad (6\text{-}2)$$

6. In Part 1, Sections 6.2, 7.1, 8.1 and 9.1 of the AISC Provisions, replace all references to Load Combinations 3-1 through 3-6 with the following; "...Load Combinations 1 through 8 of 780 CMR 1616.3.1".

7. In Part 1, Sections 8.3a, 9.4a, 9.4b and 10.8, and in Part II, Section 7.1 of the AISC Provisions, replace all references to Load Combinations 3-5 and 3-6 with the following; "...Load Combinations 7 and 8 of 780 CMR 1616.3.1".

8. In Part 1, Sections 8.7b of the AISC Provisions replace the reference to Load Combination 3-5 with the following; "...Load Combination 7 of 780 CMR 1616.3.1".

9. Special provisions for Welded Steel Moment Frames: Recent experience has shown that prequalified, welded beam-to-column moment connections used for Moment Resisting Frames are much more susceptible to damage than originally thought when the AISC Provisions were published.

The current state of knowledge indicates that the welded beam-to-column moment connections depicted in the AISC Provisions, Commentary Section 8, do not provide the level of ductility required by the Provisions for buildings that will be subjected to repeated cycles of inelastic deformation during an earthquake.

Welded beam-to-column moment connections for Special Moment Resisting Frames, Eccentrically Braced Frames and Dual Systems with Special Moment Resisting Frames shall be designed in accordance with 780 CMR 2203.2.1, Item 10.

Welded beam-to-column moment connections for Ordinary Moment Resisting Frames shall be designed in accordance with 780 CMR 2203.2.1, Item 11.

10. Design of Special Moment Resisting Frames: The design of Special Moment Resisting Frames, Eccentrically Braced Frames and Dual Systems with Special Moment Resisting Frames shall follow the procedures of the Interim Guidelines: Evaluation, Repair, Modification and Design of Welded Steel Moment Frame Structures (FEMA 267/August, 1995), except as noted herein. Chapter 7 of this document offers guidance for the design of new buildings with welded moment frames and Chapter 8 addresses metallurgy and welding. The following exceptions and clarifications shall apply to FEMA 267/August, 1995.

1. All buildings with welded beam-to-column moment connections, including light single story buildings, shall be considered to be susceptible to connection failure. The welded beam-to-column connections depicted in the AISC Seismic Provisions, Section 8, Commentary shall be prohibited for Special Moment Resisting Frames.

***Exceptions**: Buildings that will remain elastic when subject to dead and live loads, together with full seismic load, computed with R=1. An analysis that demonstrates that all components of the structure and its connections have adequate strength to resist these loads shall be submitted and approved. In addition, the requirements of 780 CMR 2203.2.1, Item 11, shall be applicable.*

2. Welded steel beam-to-column moment connection details used in the design of buildings with Special Moment Resisting Frames shall be sufficiently verified by tests of connections with similar geometry and member size. The example designs shown in Section 7.9 of FEMA 267/August 1995 shall not be permitted unless adequate data showing acceptable performance has been submitted and approved.

3. The construction documents shall set forth the connection geometry and specific design procedures demonstrating that the connections meet the design intent and comply with all requirements of 780 CMR.

11. Design of Ordinary Moment Resisting Frames: Welded beam-to-column connections depicted in the AISC Provisions, Section 8 Commentary shall be allowed for Ordinary Moment Resisting Frames provided the following provisions are met:

1. Filler metal used in critical welds, including all full penetration welds, in beam-to-column connections shall have a minimum Charpy V-Notch value of 20ft-lbs at 40 °F for fully enclosed and heated buildings and 20 ft-lbs at zero degrees Fahrenheit for other buildings or structures.

2. Backer bars shall be removed at all bottom flange welds made in the down hand position, and the root pass shall be back gouged and re-welded. A reinforcing fillet weld shall be added at the top and bottom of bottom flange full penetration welds.

3. A reinforcing fillet weld shall be added at the top of top flange full penetration welds.

4. The construction documents shall set forth, in sufficient detail, the connection geometry and specific design procedures demonstrating that the connections meet the design intent and comply with all requirements of 780 CMR

2203.3 Temporary and special stresses: Provision shall be made in the design of structural steel construction for temporary stresses that occur during erection, and for the influence of special *loads* producing impact or vibrations as provided for in 780 CMR 1614.0. Stresses caused by eccentric loading shall be fully provided for and eccentric details shall be shown on the design and shop drawings.

2203.4 Shop drawings: Complete shop drawings shall be prepared in compliance with the best modern practice in advance of the actual fabrication. Such drawings shall clearly distinguish between shop and field rivets, bolts and welds in all connections and details.

2203.5 Painting and special protection: All painting shall comply with the requirements contained in AISC ASD or AISC LRFD listed in *Appendix A*. Where exposed to highly corrosive fumes or vapors, or where subject to destruction from other highly hazardous industrial processes, all structural steelwork shall be protected by an approved method.

780 CMR 2204.0 SEISMIC REQUIREMENTS FOR STRUCTURAL STEEL

2204.1 General: Steel structural elements that resist seismic forces shall be designed in accordance with the applicable provisions of 780 CMR 2203.0, 2205.0, 2206.0 and 2207.0.

780 CMR 2205.0 OPEN-WEB STEEL JOIST CONSTRUCTION

2205.1 General: Steel joists and joist girders used as structural members in floor and roof construction shall be designed and constructed in accordance with SJI *Standard Specifications, Load Tables and Weight Tables for Steel Joists and Joist Girders* listed in ***Appendix A***.

2205.2 Partitions: The joists shall be designed to support the *dead load* of partitions, wherever they occur, in addition to all other imposed *dead* and *live loads*.

2205.3 Protection: Painting of steel joists shall be in accordance with the requirements of 780 CMR 2206.4 for formed steel construction.

2205.4 Tests: Where not subject to approved engineering analysis as regulated by 780 CMR 2205.1, the assembly shall meet the load test requirements specified in 780 CMR 1709.0 and 1710.0.

780 CMR 2206.0 FORMED STEEL CONSTRUCTION

2206.1 Design: The design of all cold-formed carbon and low-alloy steel structural members and assembled wall, floor and roof panels, used alone or in combination with other structural members, or with component materials, shall be in accordance with the AISI *Specification for the Design of Cold-Formed Steel Structural Members*, allowable stress design, hereafter referred to as AISI CFSD-ASD or the AISI *Load and Resistance Factor Design Specification for Cold -Formed Steel Structural Members* hereafter referred to as AISI CFSD-LRFD, listed in ***Appendix A***, except as modified by the provisions of 780 CMR 2206.0. The design of all cold-formed stainless steel structural members and components shall be based on a load and resistance factor design method or an allowable stress design method and maximum deflections in accordance with the ASCE *Specification for the Design of Cold Formed Stainless Steel Structural Members*, hereafter referred to as ASCE 8-SSD-LRFD, or ASCE 8-SSD-ASD listed in ***Appendix A***, except as modified by the provisions of 780 CMR 2206.3 and 2206.3.1.

2206.1.1 Composite slabs: Composite slabs of concrete on steel deck shall be designed and constructed in accordance with ASCE 3 listed in ***Appendix A***.

2206.2 Secondary structural systems: Formed steel floor, wall and roof systems are permitted to be designed and constructed to resist all vertical and horizontal moments and shears resulting from lateral forces. Such members, where designed to transmit horizontal shears due to wind or other lateral forces, shall be connected to the supporting structure so as to resist adequately all primary and secondary stresses. Where concrete topping or other approved decking is installed and strength of the composite member is included in the calculations, the concrete topping or decking shall be installed in such a manner as to insure composite action of the assembly

2206.3 Cold-formed steel structural member seismic requirements: The AISI CFSC-LRFD and ASCE 8-SSD-LRFD listed in ***Appendix A*** for the design based on the load and resistance factor design method, and the AISI CFSD-ASD and ASCE 8-SSD-ASD listed in ***Appendix A*** for the design based on the allowable stress design method, shall be modified as indicated in this section. The references to sections and paragraph numbers are to those of the particular specification modified.

1. AISI CFSD-ASD: The nominal strength of members and connections shall be in accordance with AISI CFSD-ASD, except that the nominal strength for shear and web crippling shall be determined by multiplying the allowable strength by 1.7. Design strengths shall be determined by multiplying the nominal strengths by the following resist ance factors:

   Shear strength for h/t > $(Ek_v/F_y)^{1/2}$ . . . 0.9
   Shear strength for h/t ≤ $(Ek_v/F_y)^{1/2}$ . . . 1.0
   Web crippling for members with single unreinforced webs 0.75
   Web crippling for "I" sections 0.80
   All other cases . . . . 1.55/Factor of Safety

   The notation shall have the same meaning as in AISI CFSD-ASD.
2. **Load factors**: Modify Section A5.1.4 in AISI CFSD-LRFD by substituting a *load* factor of 1.0, in place of 1.5, for nominal *earthquake loads*.
3. The strength of stainless steel structural members and connections subject to seismic forces in combination with other prescribed *loads* shall be determined by the provisions of ASCE 8-SSD-LRFD, except that combinations of *load* effects shall comply with the requirements of 780 CMR 1616.0.

2206.3.1 Steel deck diaphragms: Steel deck diaphragms shall be made from materials conforming to the requirements of AISI CFSD-

ASD, AISI CFSD-LRFD or ASCE 8-SSD- ASD listed in ***Appendix A***. Nominal strengths shall be determined in accordance with approved test procedures developed by a *registered design professional*. Design strengths shall be determined by multiplying the nominal strength by a resistance factor of 0.60.

The steel deck installation for the building, including fasteners, shall comply with the test assembly arrangement.

2206.3.2 Light gage steel-framed walls: Cold-formed steel stud walls in buildings assigned to Seismic Performance Category D in accordance with 780 CMR 1612.2.7 shall comply with 780 CMR 2206.0 and the following requirements:

2206.3.2.1 Boundary members: All boundary members, chords and collectors shall be designed to transmit the induced axial force.

2206.3.2.2 Connections: Connections for diagonal bracing members, top chord splices, boundary members and collectors shall be designed to develop the tensile strength of the member or, in those cases where (2R/5) is equal to or greater than 1 .0, (2R/5) multiplied by the design seismic force, where R is the response modification factor determined from Table 1612.4.4. The pull-out resistance of screws shall not be used to resist seismic forces.

2206.3.2.3 Braced bay members: Vertical and diagonal members in braced bays shall be anchored such that the bottom track is not required to resist uplift forces by bending of the track web. Both flanges of studs shall be braced to prevent lateral torsional buckling.

2206.4 Protection: Formed steel shall be protected in accordance with 780 CMR 2206.4.1 through 2206.4.4.

2206.4.1 Shop coat: All individual structural members and assembled panels of light gage and formed steel construction, except where fabricated of approved corrosion-resistant metallic steel or of steel having a corrosion-resistant or other approved coating, shall be protected against corrosion with an approved shop coat of paint, enamel or other approved protection.

2206.4.2 Field coat: After erection where directly exposed to the weather, except where encased in concrete made of non-corrosive aggregates, or where fabricated of approved corrosion-resistant steel, or of galvanized or otherwise adequately protected steel, individual structural members and assembled panels of light gage and formed steel construction shall be given an additional coat of approved protection.

2206.4.3 Siding: Exposed siding or sheathing shall be fabricated of approved corrosion-resistant steel or otherwise protected at the ground level for sufficient height above grade as determined by the depth of average snowfall in the locality, but not less than eight inches (203 mm).

2206.4.4 Protection at exterior walls: Floor or roof construction which extends into an exterior wall shall be adequately waterproofed and protected from the weather to prevent corrosion.

2206.5 Tests: Where not capable of design by approved engineering analysis, the code official shall require tests of the individual or assembled structural units and the connections as prescribed in 780 CMR 1709.0 and 1710.0. At least three specimens truly representative of the construction to be used in practice shall be subjected to the prescribed test and the mean of the results shall determine the safe working value; provided that any individual test varying more than 10% from the mean value shall cause rejection of the series.

2206.6 Identification: Each structural member, siding panel and roof panel of a metal building system, other than hardware items such as bolts. nuts, washers, shims and rivets, shall be identified by the manufacturer. The identification shall include the manufacturer's name or logo, and the part number or part name consistent with assembly instructions.

780 CMR 2207.0 SPECIAL STEEL AND STEEL CABLE STRUCTURAL SYSTEMS

2207.1 Special steels: Alloy, high-carbon or other special high-strength steels not covered in 780 CMR 22, where used in the design and construction of buildings and structures, shall conform to 780 CMR 1706.0.

2207.2 Structural steel cable systems: The design, fabrication and erection of steel cables used as loadbearing members in buildings and structures shall be in accordance with the AISI *Criteria for Structural Applications of Steel Cables for Buildings* listed in ***Appendix A***, except as modified by the provisions of 780 CMR 2207.2.1.

2207.2.1 Steel cable seismic requirements: The AISI *Criteria for Structural Applications of Steel Cables for Buildings* listed in *Appendix A* shall be modified as indicated in 780 CMR 2207.2. The references to sections are those of the AISI *Criteria for Structural Applications of Steel Cables for Buildings* listed in ***Appendix A***.

1. *Load* combination "d." of Section 5 shall be modified by substituting $1.5T_4$ instead of $2.0T_4$, where T_4 is the net tension in the cable due to *dead load*, prestress, *live load* and seismic *load*.
2. A *load* factor of 1.1 shall be applied to the prestress forces to be added to the *load* combination in Section 3 of the steel cable specification.

3. The effective design breaking strength in Section 6 shall be multiplied by the following resistance factors:

Members, connections and base plates that develop the strength of the members of structural systems 0.90
Connections that do not develop the strength of the member or structural system, including connections to base plates, and anchor bolts 0.67

780 CMR 2208.0 CAST-STEEL CONSTRUCTION

2208.1 Materials: Carbon steel casting for building construction shall be cast from steel conforming to AISC ASD or AISC LRFD listed in ***Appendix A***. All castings shall be free from injurious blow holes or other defects which will impair the structural strength.

2208.2 Higher strength cast steel: Higher strength cast steel shall not be used unless approved.

2208.3 Welding cast steel: Cast steel designed for use in welding shall be of weldable grade.

780 CMR 2209.0 CAST-IRON CONSTRUCTION

2209.1 Materials: Cast iron for building construction shall be a good foundry mixture providing clean, tough, gray iron that is free from serious blow holes, cinder spots and cold shuts, and that conforms to ASTM A48 listed in ***Appendix A*** for medium gray-iron castings.

2209.2 Limitations of use: Cast-iron columns shall not be used where subject to eccentric *loads* that produce a net tension in the section, nor in any part of a structural frame that is required to resist stress due to wind. The maximum stresses for cast iron shall be as indicated in Table 2209.2.

Table 2209.2
CAST-IRON STRESSES

Type of stress	Maximum stress (psi)[a]
Extreme compression (fiber stress in bending)	16,000
Extreme tension (fiber stress in bending)	3,000
Column compression	9,000 minus 40(*l/r*)
Shear	3,000
Tension	3,000
Ratio *l/r* not to exceed 70	

Note a. 1 psi = 6.895 kPa.

2209.3 Multistory columns: Cores of superimposed columns shall be of the same dimensions above and below a splice. Where a column of smaller diameter is superimposed over one of larger diameter, the larger column shall be tapered down to the smaller diameter over a length of not less than six inches (152 mm).

2209.4 Thickness of metal: The minimum thickness of cast iron shall not be less than specified in 780 CMR 2209.4.1 through 2209.4.3.

2209.4.1 Columns: In columns, the metal shall not be less than one-twelfth of the smallest dimension of the cross section and not less than ¾ inch (19 mm).

2209.4.2 Bases and brackets: In bases and flanges, the metal shall not be less than one inch (25 mm) thick, and shall be reinforced with fillets and brackets.

2209.4.3 Lintels: In lintels, the metal shall not be less than ¾ inch (19 mm) thick, and shall be limited to use on spans of not more than six feet (1829 mm).

2209.5 Inspection: A cast-iron column shall not be erected in place before such column has been inspected and approved. The use of any cast-iron column in which blow holes or imperfections reduce the effective area of the cross section more than 10% shall be prohibited. Where required by the code official, ⅜-inch (10 mm) round inspection holes shall be drilled in the section to expose the thickness of metal for inspection purposes.

780 CMR 2210.0 EXTERIOR STEEL FRAME CORROSION PROTECTION UNDER MASONRY

2210.1 Required: Exterior steel columns and girders, before embedment in masonry of the required fireresistance rating specified in Table 602, shall be protected from moisture by an approved waterproofing material, a parging coat of cement mortar or by a minimum of eight inches of weather-tight masonry.

NON-TEXT PAGE

CHAPTER 23

WOOD

780 CMR 2301.0 GENERAL

2301.1 Scope: The provisions of 780 CMR 23 shall govern the materials, design, construction and quality of wood.

780 CMR 2302.0 DEFINITIONS

2302.1 General: The following words and terms shall, for the purposes of 780 CMR and as used elsewhere in 780 CMR, have the meanings shown herein.

Native lumber: Native lumber is wood processed in the Commonwealth of Massachusetts by a mill registered in accordance with 780 CMR. Such wood may be ungraded but is stamped or certified in accordance with the requirements of 780 CMR R-4. Native lumber shall be restricted to use in one- and two-story dwellings, barns, sheds, agricultural and accessory buildings and other structures when permitted by 780 CMR 2303.

Nominal dimension (lumber): A dimension that varies from actual dimensions in accordance with DOC PS 20 listed in *Appendix A*.

Particleboard: Particleboard is a mat-formed panel consisting of particles of wood or a combination of wood particles and wood fibers bonded together with synthetic resins or other suitable bonding systems (see 780 CMR 2308.0).

Preservative treatment (treated material): Unless otherwise noted, means impregnation under pressure with a wood preservative. A wood preservative is any suitable substance that is toxic to fungi, insects, borers and other living wood-destroying organisms.

780 CMR 2303.0 PERFORMANCE REQUIREMENTS

2303.1 Structural design: All structural wood members and connections shall be of sufficient size or capacity to carry all design *loads* as required by 780 CMR 16 without exceeding the allowable design values specified in AFPA NDS listed in *Appendix A*. Trusses and long-span girders shall be designed with sufficient camber, or other provision shall be made to counteract any deflection other than that permitted in 780 CMR 1606.5. Design values shall be adjusted for wood that is pressure impregnated with fireretardant chemicals. Such adjustment shall be in accordance with 780 CMR 2310.2.1.

2303.1.1 Identification: All lumber utilized for *load*-supporting purposes, including end-jointed or edge-glued lumber, shall be identified by the grade mark of an approved lumber grading or an *approved inspection agency*. Grading practices and identification shall be in accordance with rules published by an *approved agency*. In lieu of a grade mark on the material, a certificate of inspection as to species and grade which is issued by an approved lumber grading or an *approved inspection agency* shall be accepted for precut, remanufactured or rough-sawn lumber, and for sizes larger than three inches nominal in thickness. Fireretardent-treated wood shall be *labeled* in accordance with 780 CMR 2310.2.2.

2303.2 Native lumber: Native lumber, as defined in 780 CMR 2302.1 shall be acceptable for use in one and two story dwellings, barns, sheds, agricultural and accessory structures. Native lumber shall also be acceptable for use in other one and two story structures as columns when the design loads are 25% greater than required elsewhere by 780 CMR; as joists, principal beams, and girders in floor constructions when the design loads are 15% greater than required elsewhere by 780 CMR; and as other elements when the design loads are as required elsewhere by 780 CMR.

Each piece of native lumber produced shall be stamped with the name and registration number of the producer in accordance with the 780 CMR. In addition, all native lumber shall bear an approved mark identifying the species of wood. In lieu of the stamp bearing the name and registration number and species identification, a certification bearing the same information may be provided by the producer for precut or re-manufactured lumber in accordance with 780 CMR. When native lumber is used, it shall be subject to the following requirements:

1. ***Sizing criteria: For lumber, sized in accordance with the DOC PS-20-70, figures for maximum fiber stress and modulus of elasticity for framing grade No. 2 will be used in establishing span and spacing characteristics for all structural members.***
2. ***Stress criteria: Lumber which is sized in excess of the dimensions established by the DOC PS-20-70 for the given nominal size referenced shall be allowed to have a maximum fiber stress increase above that provided in 780 CMR 2303.2 item 1 in proportion to the increased bearing capacity of the cross section as provided in Table 2303.2 or as calculated.***

TABLE 2303.2
NATIVE LUMBER - ALLOWABLE STRESSES

Nominal Size	Actual Lumber Size Closest size which does not exceed the size shown)	Multiplier factor based on lumber width	Factor to be added to multiplier factor for lumber oversized in thickness	
	Actual Size (thickness x width)		Thickness increase of ¼" to ½"	Thickness increase of over ½" to 1"
3 x 8	2½ x 7½	1.0 x Fs	+0.10	+0.20
	2½ x 7¾	1.07		
	2½ x 8	1.14		
3 x 10	2½ x 9½	1.0	+0.10	+0.20
	2½ x 9¾	1.05		
	2½ x 10	1.11		
3 x 12	2½ x 11½	1.0	+0.10	+0.20
	2½ x 11¾	1.04		
	2½ x 12	1.09		
3 x 14	2½ x 13½	1.0	+0.10	+0.20
	2½ x 13¾	1.04		
	2½ x 14	1.07		
4 x 10	3½ x 9½	1.0	+0.07	+0.14
	3½ x 9¾	1.05		
	3½ x 10	1.11		
4 x 12	3½ x 11½	1.0	+0.07	+0.14
	3½ x 11¾	1.04		
	3½ x 12	1.09		
4 x 14	3½ x 13½	1.0	+0.07	+0.14
	3½ x 13¾	1.04		
	3½ x 14	1.08		

2303..3 Fireresistance: All wood structural elements shall comply with Table 602.

2303.4 Flameresistance: All wood surfaces used as interior finishes and all exposed surfaces as described in 780 CMR 801.1 shall conform to the requirements of 780 CMR 803.0.

2303.5 Combustibility: Wood used as structural elements or portions thereof shall be limited to combustible structural elements as required by 780 CMR.

Exceptions:
1. Fireretardant-treated wood as permitted by Table 602, Note d, and which complies with 780 CMR 2310.0.
2. As specifically permitted by 780 CMR 602.4.1.

780 CMR 2304.0 HEAVY TIMBER CONSTRUCTION

2304.1 Material grade and design: All structural wood members, sawn or glued-laminated, which are installed in buildings and structures of Type 4 construction shall be stress-grade timbers identified as to grade and strength by *approved manufacturing, testing* or *in spection agencies* or *bureaus*. All structural timber members shall have the minimum dimensions specified in 780 CMR 2304.3 through 2304.6 for buildings and structures of Type 4 construction and shall be designed, fabricated and installed in accordance with AFPA NDS and AITC 108, 112, 117, 119 and A190.1 listed in ***Appendix A***.

2304.2 Steel or concrete: Structural steel or reinforced concrete members shall not be substituted for timber in any part of the structural frame unless *protected* to develop the required fireresistance rating specified in Table 602, but not less than a one-hour fireresistance rating. Structural members that support walls shall be *protected* to afford the same fireresistance rating as the wall supported.

2304.3 Columns: Wood columns shall be sawn or glued-laminated and shall not be less than eight inches nominal in any dimension where supporting floor *loads;* not less than six inches nominal in width, and not less than eight inches nominal in depth where supporting only roof and ceiling *loads*. Columns shall be continuous or superimposed throughout all stories by means of reinforced concrete or metal caps with brackets, or shall be connected by properly designed steel or iron caps, with pintles and base plates, or by timber splice plates affixed to the columns by means of metal connectors housed within the contact faces, or by other approved methods. Girders or trusses which support columns shall have at least a one-hour fireresistance rating.

2304.4 Floors: Floors shall be without concealed spaces and shall be constructed of sawn, glued-laminated, splined or tongue-and-groove planks not less than three inches nominal in thickness and covered with a one-inch nominal dimension tongue-and-groove flooring, laid crosswise or diagonally, or 15/32-inch wood structural panel or ½-inch *particleboard*; or of planks not less than four inches nominal in width that are set on edge close together and securely spiked, and covered with one-inch *particleboard*. The lumber shall be laid so that a continuous line of joints will not occur except at points of support and so that planks are not spiked to supporting girders that are parallel to the lamination of the floor. Floors and flooring shall not extend closer than ½-inch (13 mm) to walls so as to provide an expansion joint. Such ½-inch (13 mm) spaces shall be covered by a molding fastened to the wall either above or below the floor and arranged such that the molding will not obstruct the expansion or contraction movements of the floor, or, as an alternative, corbeling of masonry walls under floor shall be utilized in place of molding.

2304.4.1 Floor joists, beams and girders: Joists, beams and girders of wood shall be constructed of sawn or glued-laminated timber and shall not be less than six inches nominal in width, and not less than ten inches nominal in depth. Framed sawn or glued-laminated timber arches that spring from the floor line and support floor *loads* shall not be less than eight inches nominal in any dimension. Framed timber trusses supporting floor *loads* shall have members of not less than eight inches nominal in any dimension.

2304.5 Roofs: Roofs shall be without concealed spaces and roof decks shall be constructed of: sawn, glued-laminated, splined or tongue-and-groove planks not less than two inches nominal in thickness; 1⅛-inch-thick interior wood structural panel (exterior glue); or of planks not less than three inches nominal in width that are set on edge close together and laid as required for floors in 780 CMR 2304.4.

2304.5.1 Arches: Framed or glued-laminated arches for roof construction which spring from the floor line or from grade and do not support floor *loads* shall have members not less than six inches nominal in width, not less than eight inches nominal in depth for the lower half of the height and not less than six inches nominal in depth for the upper half. Framed or glued-laminated arches for roof construction which spring from the top of walls or wall abutments, framed timber trusses and other roof framing which does not support floor *loads* shall have members not less than four inches nominal in width and not less than six inches nominal in depth. Spaced members shall be composed of two or more pieces not less than three inches nominal in thickness where blocked solidly throughout their intervening spaces or where such spaces are tightly closed by a continuous wood cover plate of not less than two inches nominal in thickness, secured to the underside of the members. Splice plates shall not be less than three inches nominal in thickness. Where equipped with an *automatic sprinkler system* installed in accordance with 780 CMR 906.2.1, 906.2.2 or 907.0 under the roof deck, framing members shall not be less than three inches nominal in width.

2304.6 Interior wall construction: Walls shall be of solid wood construction formed by not less than two layers of one-inch matched boards, laminated construction four inches in thickness, or of one-hour fireresistance rated construction.

2304.7 Exterior structural members: Wood columns and arches conforming to heavy timber sizes shall only be installed externally where a *fire separation distance* of 20 feet (6096 mm) or more is provided. Where a *fire separation distance* of less than 20 feet (6096 mm) is provided, columns and arches shall be permitted where located inside an exterior wall, and the exterior wall has a fireresistance rating not less than required by Table 602, for exterior walls.

2304.8 Beams and girders: Beams and girder supports and connections shall comply with 780 CMR 2305.6.3 and 2305.6.4.

2304.9 Column connections: Girders and beams shall be closely fitted around columns and adjoining ends shall be cross tied to each other, or inter-tied by caps or ties, to transfer horizontal *loads* across the joint. Wood bolsters shall not be placed on tops of columns unless the columns support roof *loads* only.

2304.10 Maintenance: All connections in the joints of timber trusses and structural frames shall be inspected periodically. Bolts and other connectors shall be maintained tight.

2304.11 Framing around flues and chimneys: Clearances for combustible framing members from all flues, chimneys and fireplaces shall be in accordance with 780 CMR 2305.12.

780 CMR 2305.0 WOOD FRAME CONSTRUCTION

2305.1 Design and construction: Exterior walls, interior partitions, floors and roofs of wood construction shall be designed and constructed in accordance with 780 CMR 2305.0, 780 CMR 2303.0 and 780 CMR 2307.0 through 2312.0.

2305.2 Fastening: The quantity and size of fasteners connecting wood frame members together and sheathing materials to wood frame members shall not be less than that specified in Table 2305.2.

2305.3 Cutting and notching: It shall be unlawful to notch, cut or pierce wood beams, joists, rafters or studs in excess of the limitations herein specified, unless proven safe by structural analysis or suitably reinforced to transmit all calculated *loads*.

2305.3.1 Notches: Notches in joists, rafters and beams shall not exceed 1/6 of the depth of the member, shall not be longer than ⅓ of the depth of the member and shall not be located in the middle ⅓ of the span. Notch depth at the ends of the member shall not exceed ¼ of the depth of the member.

Exceptions:

1. A notch over the support is permitted to extend the full width of the support.
2. Notches on cantilevered portions of the member are permitted to extend the full length of the cantilever if the strength and deflection of the cantilever is calculated based on the reduced member section.
3. The tension side of beams, joists and rafters which are four inches or greater in nominal thickness, shall not be notched, except at ends of members.

Table 2305.2
FASTENING SCHEDULE

Building element	Nail or staple size and type	Number and location
1. Floor construction		
Built up to girders and beams	20d common	32" o.c. direct
Bridging to joists	8d common	2 each direct end
Floor joists to studs (no ceiling joists)	10d common 10d common	5 direct or 3 direct
Floor joists to studs (with ceiling joists)	10d common	2 direct
Floor joists to sill or girder	8d common	3 toe nail
Ledger strip	16d common	3 each direct joist
1" subflooring (6" or less)	8d common	2each direct joist
1" subflooring (8" or more)	8d common	3 each direct joist
2" subflooring	16d common	2 each direct joist
Particleboard underlayment (¼" - ¾")	6d annular threaded	6" o.c direct edges and 12" o.c. intermediate
Particleboard subflooring (⅝ or greater)	8d common	6" o.c direct edges and 12" o.c. intermediate
Wood structural panel subflooring		
(½" or less)	6d common *or* 6d annular or spiral thread	6" o.c direct edges and 12" o.c. intermediate
(19/32" - ¾")	8d common *or* 6d annular or spiral thread	6" o.c direct edges and 12" o.c. intermediate
(⅞" - 1⅛)	10d common *or* 8d ring shank *or* 8d annular or spiral thread	6" o.c direct edges and 6" o.c. intermediate
(½" or less)	16 gage galvanized wire staples	4" o.c. edges and 7" o.c.intermediate
(19/32", ⅝")	⅜" minimum crown, 1⅝" length	2½" o.c. edges and 4" o.c. intermediate
2. Wall construction		
Stud to sole plate	8d common 16d common	4 toe nail or 2 direct nail
Stud to cap plate	16d common	2 toe nail or 2 direct nail
Double studs	10d common	12" o.c. direct
Corner studs	16d common	24" o.c. direct
Sole plate to joist or blocking	16d common	16" o.c.
Interior-braced wall sole plate to parallel joist	16d common	12" o.c.
Double cap plate	10d common	16" o.c. direct nail
Cap plate laps	10d common	2 direct nail
Ribbon strip 6" or less	10d common	2 each direct bearing
Ribbon strip 6" or more	10d common	3 each direct bearing
Diagonal brace (to stud and plate)	8d common	2 each direct bearing

Building element	Nail or staple size and type	Number and location
Interior -braced wall top plate to joist or blocking	10d common	12" o.c.
Tail beams to headers (where nailing is permitted)	20d common	1 each end 4 sq. ft. floor area
Header beams to trimmers (where nailing is permitted)	20d common	1 each end 8 sq. ft. floor area
Continuous header to stud	8d common	4 toe nail
Continuous header, two pieces	16d common	16" o.c. direct
3. Roof and ceiling construction		
Ceiling joists to plate	16d common	3 toe nail
Ceiling joists (laps over partition)	10d common	3 direct nail
Ceiling joists (parallel to rafter)	10d common	3 direct nail
Collar beam	10d common	3 direct
Roof rafter to plate	8d common	3 toe nail
Roof rafter to ridge	16d common	2 toe nail or direct nail
Jack rafter to hip	10d common 16d common	3 toe nail or 2 direct nail
1" roof decking (6" or less in width)	8d common	2 each direct rafter
1" roof decking (over 6" in width)	8d common	3 each direct rafter
4. Wall and roof sheathing		
1" wall sheathing (8" or less in width)	8d common	2 each direct stud
1" wall sheathing (over 8" in width)	8d common	3 each direct stud
Diagonal wall sheathing (seismic bracing)	See Table 2306.4.5	
½" fiberboard sheathing	1½" galvanized roofing nail or 6d common nail *or* 16 gage staple, 1⅛" long with minimum crown of 7/16"	3" o.c. exterior edge, 6" o.c. intermediate
25/32" fiberboard sheathing	1¾" galvanized roofing nail *or* 8d common nail *or* 16 gage staple, 1½" long with minimum crown of 7/16"	3" o.c. exterior edge, 6" o.c. intermediate
Gypsum sheathing	12 gage 1¼" large head, corrosion resistant	4" o.c. on edge, 8" o.c. intermediate
Gypsum sheathing (seismic bracing)	11 gage 1¾" long 7/16" head, diamond point, galvanized	4" o.c. all bearing points
Particleboard roof and wall sheathing		
(½" or less)	6d common	6" o.c. direct edges and 12" o.c. intermediate
(⅝" or greater)	8d common	6" o.c. direct edges and 12" o.c. intermediate
Wood structural panel roof and wall sheathing		
(½" or less)	6d common	6" o.c. direct edges and 12" o.c. intermediate
(19/32" or greater)	8d common	6" o.c. direct edges and 12" o.c. intermedite
(½" or less)	16 gage galvanized wire staples, ⅜" minimum crown; length of 1" plus panel thickness	4" o.c. edges and 8" o.c. intermediate
(19/32", ⅝")	Same as immediately above	2½" o.c. edges and 5" o.c. intermediate
Shingles, wood[a]	No. 14 B&S Gage corrosion resistant	2 each bearing
Weatherboarding	8d corrosion resistant	2 each bearing

Note a. Single nails shall penetrate not less than ¾ inch into nailing strips, sheathing or supporting construction except as otherwise provided for in 780 CMR 1507.0

2305.3.2 Holes: Holes bored or cut into joists, rafters or beams shall not be closer than two inches (51 mm) to the top or bottom of the joist, or to any other hole located in the member. Where the member is notched, the hole shall not be closer than two inches (51 mm) to the notch. The diameter of the hole in joists shall not exceed ⅓ of the depth of the member.

2305.3.3 Studs: In studs of loadbearing walls or partitions, notches or bored holes shall not be cut or bored more than ⅓ of the depth of the stud unless reinforced in accordance with 780 CMR 2305.3.4.

2305.3.4 Reinforcement: Where the stud is cut or bored in excess of ⅓ of its depth, the stud shall be reinforced to be equal in loadbearing capacity to a stud that is notched not more than ⅓ of its depth.

2305.4 Loadbearing walls: Posts and studs in loadbearing walls and partitions shall be designed as columns, with due allowance for lateral support furnished by sheathing, intermediate bracing, horizontal bridging, wall coverings and the floor and roof assemblies. The walls shall be fabricated in such a manner as to provide adequate support for the materials that enclose the building and to provide for transfer of all lateral *loads* to the foundation in accordance with 780 CMR 1710.4.

2305.4.1 Wall framing: Studs shall be placed with the wide dimension perpendicular to the wall. Not less than three studs shall be installed at each corner of an exterior wall.

Exception: At corners, a third stud is not required where wood spacers or backup cleats of ⅜-inch-thick wood structural panel, ⅜-inch Type 2-M *particleboard*, one-inch-thick lumber or other approved devices which serve as an adequate backing for the attachment of facing materials are used. Where fireresistance ratings or shear *loads* apply, wood spacers, backup cleats or other devices shall not be installed unless specifically approved.

2305.4.2 Double top plates: Stud walls shall be capped with double top plates installed to provide overlapping corners and wall intersections. Top plate joints shall be offset not less than 48 inches (1219 mm).

Exception: Detached one- and two-family dwellings and agricultural storage buildings that are intended only for incidental human occupancy are permitted to have a single top plate provided that the plate is adequately tied at joints, corners and intersecting walls by at least the equivalent of galvanized steel that is three inches (76 mm) by six inches (152 mm) by 0.036 inches thick and nailed to each wall or segment of wall by three 8d nails or the equivalent, and the rafters, joists or trusses are centered over the studs with a tolerance of not more than one inch (25 mm).

2305.4.3 Bottom plates: Studs shall have full support by a plate or sill. The sill shall have not less than a two-inch nominal thickness and a width at least equal to the width of the studs.

2305.5 Nonloadbearing walls: Studs in nonloadbearing walls and partitions shall not be spaced more than 48 inches (1219 mm) o.c., and are permitted to be erected with the long dimension parallel to the wall, unless otherwise approved as an integrated assembly by testing. A single top plate shall be prohibited except where such plate is installed in accordance with 780 CMR 2305.4.2.

2305.6 Support and anchorage: Support and anchorage of members on girders, walls and beams shall conform to 780 CMR 2305.6.1 through 2305.6.4.

2305.6.1 Support and anchorage on girders: All members framing into girders shall be anchored or tied to secure continuity. The ends of all wood beams that rest on girders shall bear not less than four inches (102 mm) or shall be supported in approved metal stirrups, hangers or on wood clips or ribbon strips. Beams framing from opposite sides shall either lap at least six inches (152 mm) and be bolted or spiked together or, where framed end-to-end, the beams shall be secured together by approved ties, straps, dogs, plates or sheathing.

2305.6.2 Support and anchorage on walls or beams: Except where supported on a 1 x 4 ribbon strip and nailed to the adjoining stud, joists shall bear on walls or beams of wood or steel not less than 1½ inches (38 mm) or shall be supported by metal stirrups, hangers or a nominal 2-inch wood ledger strip. The minimum bearing on concrete or masonry shall be three inches (76 mm). Joists framing over beams from opposite sides shall either lap at least three inches (76 mm) and be securely fastened together or, where framed end-to-end, the joists shall be secured together by approved ties, straps, dogs, plates or sheathing.

2305.6.3 Girder supports: Wall plate boxes of the self-releasing type, or approved hangers, shall be provided where beams and girders are supported by masonry. An air space of ½ inch (13 mm) shall be provided at the top, end and sides of the member unless approved naturally durable or *preservative-treated* wood in accordance with 780 CMR 2311.0 is installed. Wood beams and girders supported by walls required to have a fireresistance rating of two hours or more shall have not less than four inches (102 mm) of solid masonry between their ends and the outside face of the wall and between adjacent beams.

2305.6.4 Fire cuts: All wood and other combustible floor, roof and other structural members framing into masonry walls shall be cut to a bevel of three inches (76 mm) in depth and shall project not more than four inches (102 mm) into the wall.

2305.7 Wind bracing: In buildings more than one story in *height* and where necessary for strength in one-story buildings, the corner posts shall be the equivalent of not less than two pieces of two-inch by four-inch studs, braced by not less than one piece of one-inch by four-inch continuous-diagonal brace let into the studs. Bracing is not required where diagonal wood sheathing, wood structural panels or *particleboard* panels are installed, or where other sheathing as specified in 780 CMR 2305.13 is applied vertically in panels of not less than four feet by eight feet with approved fasteners complying with Table 2305.2. Other sheathing materials shall be permitted when tested in accordance with ASTM E72 listed in ***Appendix A***.

The lateral *load* resistance shall be established by the lesser of: the values determined by dividing the maximum *load* reported in the test by 2.5; or the *load* at which the deflection reported in the test exceeds *h*/480, where *h* is the height of the test assembly.

2305.8 Seismic bracing: Where structural analysis of the seismic force-resisting system is not provided, buildings shall meet the provisions of 780 CMR 2305.0 and shall have roof and exterior wall *dead loads* less than or equal to 15 psf (73 kg/m^2) and floor *dead loads* less than or equal to 10 psf (49 kg/m^2).

Table 2305.8
WALL SPACING AND HEIGHT LIMITATIONS FOR WOOD AND FRAME CONTRUCTION

Seismic Performance Category	Maximum distance between interior bracing walls (feet)	Maximum Stories (height) permitted
C	25	2 (30 feet)
D[a]	25	1 (20 feet)

Note a: Applies only to Seismic Hazard Exposure Group I; engineering analysis required for Seismic Hazard Exposure Group II

2305.8.1 Wall bracing required: All exterior walls and required interior bracing walls shall be braced by one of the types of sheathing prescrided in table 2305.8.1 for each 25 lineal feet (or 7.6 m) of exterior wall or required interior bracing wall length. The required length of sheathing shall be distributed along the length of the bracing wall with a minimum four foot panel of sheathing at, or within four feet of, each end. Construction of bracing walls shall comply with the requirements of 780 CMR 2305.9

Table 2305.8.1
MINIMUM SEISMIC WALL BRACING PER 25 LINEAL FEET OF INTERIOR AND EXTERIOR WALL LENGTH[a,c]

Story location	Sheathing[b]	$A_v = 0.12$
Top or only story	GP	7’-0”
	W/SP	4’-0”
First of two stories or second of three stories	GP	13’-0”
	W/SP	7’-0”
First of three stories	GP W/SP	Note c.

Note a. Interpolation of the tabular values is permitted where the length of wall between exterior walls or interior-braced walls is less than 25 feet.

Note b. GP = Gypsum or *particleboard* sheathing; W/SP = Diagonal wood boards or wood structural panels.

Note c. Analysis of the seismic force-resisting system required.

Note d. One foot = 304.8 mm.

2305.8.2 Double-sheathed walls: Where braced walls are sheathed on both sides with identical sheathing, the required length of sheathing in Table 2305.8.1 is permitted to be taken as ½ the tabular length. Where different sheathing materials are used on either side of a wall, the required length of sheathing in Table 2305.8.1 is permitted to be taken as ½ of the tabular length for the material requiring the greater length. Double-sheathed walls shall have a minimum length of four feet (1219 mm).

2305.8.3 Stud walls: Stud walls that are less than the full height of the story shall be braced as required for exterior walls or interior-braced walls and shall be considered an additional story.

2305.8.4 Sheathing installation: Sheathing shall be installed in accordance with the provisions of Table 2305.13 where acting as wall bracing. To be considered effective as bracing, the sheathing shall be at least 48 inches in width covering three 16-inch stud spaces or two 24-inch stud spaces and be fastened to the wall studs in accordance with Table 2305.2. Sheathing shall be fastened to the wall studs, sole plate and top plate in accordance with Table 2305.2. All vertical joints of panel sheathing shall occur over studs and all horizontal joints shall occur over blocking at least equal in size to the studs. All framing in connection with sheathing used for bracing shall not be less than two inches nominal in thickness.

2305.9 Braced wall: All exterior walls and interior-braced walls required by Table 2305.8, shall be constructed to transfer forces from roofs and floors to braced walls and from the braced walls in upper stories to the braced walls in the story below. Braced wall lines from the story above to the story below are permitted to be offset a maximum of 24 inches (610 mm). Blocking, where required by 780 CMR 2305.9, need only be provided for the length of the wall specified in Table 2305.8.1.

2305.9.1 Roof to braced wall connections: Roof to interior-braced wall connections for buildings with maximum dimensions not over 50 feet (15240 mm) are permitted to be made at the intersection of exterior walls. Double top plates shall be lapped at the intersection and nailed in accordance with Table 2305.2. For buildings with maximum dimensions greater than 50 feet (15240 mm), the interior-braced walls shall be fastened directly to the ceiling joist in accordance with 780 CMR 2305.9.2 or 2305.9.3.

2305.9.2 Parallel floor joist and braced wall connections: Where the floor framing is parallel to the braced wall line, joists shall be doubled directly beneath the braced wall line and nailed in accordance with Table 2305.2.

Where the upper and lower braced walls are offset, the joist spaces between the offset braced walls shall be blocked with a minimum blocking size of two inches by six inches, spaced at 32 inches (813 mm) on center, within the joist cavity under the braced wall, and positioned in the upper portion of the cavity. The upper braced wall is permitted to be nailed to the blocking with two 16d nails at each piece of blocking. The lower braced wall shall be toe nailed, in accordance with Table 2305.2, to a joist located directly above the top plates.

2305.9.3 Perpendicular floor joist and braced wall connections: Where the floor framing is perpendicular to the braced wall line, solid blocking for the full depth of the floor joist shall be provided for the length of bracing required. The interior-braced wall shall be nailed to the blocking in accordance with Table 2305.2.

Where the upper and lower braced walls are offset, a minimum of two-inch by six-inch blocking shall be located in the upper portion of the joist space, directly beneath the upper braced wall and in the lower portion of the joist space, directly above the lower braced wall.

2305.10 Multiple stories: Where the frame is more than one story in *height* and studs and posts are not continuous from sill to roof, the members shall be secured together with approved clips, splices or other connections to insure a continuous, well-integrated structure. Sheet metal clamps, ties or clips shall be formed of galvanized steel or other approved corrosion-resistant material equivalent to 0.040-inch nominal thickness steel sheets for two-inch framing members and not less than 0.052-inch nominal thickness steel sheets for three-inch structural members. For four-inch and larger members, column splices and beam and girder supports shall comply with 780 CMR 2304.1.

2305.11 Framing over openings: Headers, double joists, trusses or other approved assemblies which are of adequate size to transfer all superimposed *loads* to the vertical members shall be provided over all window and door openings in loadbearing walls and partitions.

2305.12 Framing around flues and chimneys: Combustible framing shall be a minimum of two inches (51 mm), but shall not be less than the distance specified in 780 CMR 2114.0 and the mechanical code listed in ***Appendix A***, from all flues, chimneys and fireplaces, and six inches (152 mm) away from flue openings.

2305.13 Wall sheathing: Except as provided for in 780 CMR 1405.3 for weatherboarding or where stucco construction that complies with 780 CMR 2506.0 is installed, all enclosed buildings shall be sheathed with one of the materials of the nominal thickness specified in Table 2305.13 or any other approved material of equivalent strength and durability.

Table 2305.13
MINIMUM THICKNESS OF WALL SHEATHING

Sheathing type	Minimum thickness	Maximum shear wall stud spacing[a]
Wood boards	5/8 inch	24 inches on center
Fiberboard	7/16 inch	16 inches on center
Wood structural panel	In accordance with Table 2307.3.5	
2-M-1 or 2-M-W Particleboard	In accordance with Table 2308.5(2)	
Gypsum sheathing	½ inch	16 inches on center
Gypsum wallboard	½ inch	24 inches on center
Reinforced cement mortar	1 inch	24 inches on center

Note a. 1 inch = 25.4 mm.

2305.13.1 Wood structural panel wall bracing: In buildings assigned to Seismic Performance Category D, where wood structural panel sheathing is installed structurally as covering on the exterior of outside walls, such sheathing shall be of the exterior type. Where used elsewhere structurally, wood structural panel sheathing shall be bonded by intermediate or exterior glue.

2305.13.2 Paper-backed lath sheathing: In occupancies in Use Group R-3 and one-story commercial buildings with brick or similar veneers, the sheathing shall conform to 780 CMR 2305.13 or shall consist of a layer of paper-backed lath complying with 780 CMR 2505.0 and a one-inch (25 mm) intermediate space which shall be mortar filled as each course of veneering is applied.

2305.14 Flooring: The flooring of wood frame construction shall be of adequate strength and stiffness to support required *loads* and, where necessary for strength and for lateral support of the building, subflooring shall be provided.

2305.14.1 Floor spans: Design stresses of floor joists shall be determined in accordance with AFPA NDS listed in ***Appendix A***. Metal-plate-connected floor trusses shall be designed in accordance with TPI *Design Specifications for Metal Plate Connected Parallel Chord Wood Trusses* and AFPA NDS listed in ***Appendix A***.

2305.14.2 Bridging: In all floor, *attic* and roof framing, except as hereafter noted, there shall not be less than one line of bridging for each eight feet (or 2450 mm) of span. The bridging shall consist of not less than one-inch by three-inch lumber, double nailed at each end, or of equivalent metal bracing of equal rigidity. A line of bridging shall also be required at supports where adequate lateral support is not otherwise provided. Midspan bridging is not required for floor, *attic* or roof framing in occupancies in Use Groups R-2 and R-3, except where the joist depth exceeds 12 inches nominal or where the minimum uniformly distributed *live load* exceeds 40 psf (195 kg/m^2).

2305.15 Roof spans: Design stresses of rafters shall be determined in accordance with AFPA NDS listed in Appendix A. Metal-plate-connected roof trusses shall be designed in accordance with TPI *Design Specifications for Metal Plate Connected Wood Trusses* and AFPA NDS listed in *Appendix A*, and shall be braced to prevent rotation and provide lateral stability.

2305.15.1 Roof decking and sheathing: Roof deck sheathing shall consist of not less than ⅝-inch boards, wood structural panel of the thickness specified in 780 CMR 2307.3, *particleboard* of the grade and thickness specified in 780 CMR 2308.4, or other approved materials of equivalent strength and rigidity. Where open deck sheathing is used on pitched roofs, such sheathing shall consist of not less than one-inch by four-inch roofers spaced not more than six inches (152 mm) on center, or of material of equivalent strength and rigidity.

2305.16 Foundation anchorage: Wall sill plates, minimum of two-inch by four-inch members, shall be sized and anchored to foundation walls or piers and at intermediate intervals as required to resist wind uplift. Foundation anchorage shall be provided by the installation of anchor bolts or other approved anchoring method. Anchor bolts shall be of a minimum diameter of ½ inch. The bolts shall be embedded in foundations to a depth of not less than eight inches (203 mm) of cast-in-place concrete, and not less than 15 inches (381 mm) in grouted unit masonry. There shall be a minimum of two anchor bolts per section of plate and anchor bolts shall be placed 12 inches (305 mm) from the end of each section of plate, with intermediate bolts spaced a maximum of six feet (1829 mm) on center for one- and two-story buildings and not more than four feet (1219 mm) on center for buildings over two stories in height.

Exception: Agricultural storage buildings which are intended only for incidental human occupancy, are permitted to have maximum intermediate bolt spacings of eight feet (or 2450 mm).

2305.17 Fire cuts: All wood structural members which frame into masonry walls shall conform to 780 CMR 2305.6.4.

780 CMR 2306.0 SEISMIC REQUIREMENTS FOR WOOD AND TIMBER

2306.1 General: All buildings for which a seismic analysis is required, in accordance with 780 CMR 1612.2, and which are constructed partially or wholly of wood or wood-based materials shall be designed in accordance with the provisions of 780 CMR 2306.0 and 780 CMR 2305.0.

2306.2 Definitions: The following words and terms shall apply to the provisions of 780 CMR 2306.0 and have the following meanings:

Blocked diaphragm: A diaphragm in which all sheathing edges not occurring on a framing member are supported on and connected to blocking.

Diaphragm: A horizontal or nearly horizontal system designed to transmit lateral forces to the vertical elements of the seismic-resisting system.

Wood shear panel: A wood floor, roof or wall component sheathed to act as a shear wall or diaphragm.

2306.3 Strength of members and connections: The allowable *load* capacities of 780 CMR 2306.0 are to be utilized with allowable stress design *load* combinations.

2306.4 Engineered timber construction: Where seismic analysis is required in accordance with 780 CMR 1612.2, the proportioning and design of wood systems, members and connections shall be in accordance with 780 CMR 2306.4 and AFPA NDS listed in *Appendix A*.

2306.4.1 Column framing requirements: All wood columns shall be provided with full end support. Columns shall be provided with adequate support to maintain stability. Positive connections shall be provided to resist uplift and lateral displacement.

2306.4.2 Wood shear panels: Wood shear panels shall comply with 780 CMR 2306.4.2.1 through 2306.4.2.6. Diaphragm construction shall comply with 780 CMR 2306.4.3. Shear wall construction shall comply with 780 CMR 2306.4.4. The construction of wood shear panels shall comply with 780 CMR 2306.4.5 for diagonally sheathed lumber shear panels, 780 CMR 2306.4.6 for wood structural panel sheathed shear panels, 780 CMR 2306.4.7 for *particleboard* sheathed shear panels, or 780 CMR 2306.4.8 for other shear panel sheathing.

2306.4.2.1 Framing members: All framing members stalled in shear panel construction shall be at least two inches nominal in thickness. Boundary members, and chords in diaphragms and shear walls and collectors transferring forces to such elements shall be designed and detailed for the axial forces. Boundary members shall be connected at all corners.

2306.4.2.2 Opening details: Openings in shear panels shall be designed and detailed to transfer the shear and axial forces induced by the discontinuity created by the opening and the details shall be shown on the approved plans.

2306.4.2.3 Connection and anchorage details: Positive connections and anchorages, capable of resisting the design forces, shall be provided between the shear panel and the attached components. Concrete or masonry wall anchorage shall not be accomplished by installation of toe nails, or nails subject to withdrawal and wood ledgers shall not be installed in cross-grain bending or tension.

2306.4.2.4 Torsion: The diaphragms in buildings having torsional irregularity, where the lateral stiffness ratio of the structural members is greater than four to one, or in buildings with one line of resistance in either orthogonal direction, shall be sheathed with diagonal boards or wood structural panels. The length of the diaphragm normal to the soft side shall not exceed 25 feet (or 7600 mm) nor shall the diaphragm length-to-width ratio exceed 1.0 for one-story buildings or 0.67 for buildings over one story in height.

Exception: Where calculations demonstrate that the diaphragm deflections will be tolerated, the length limitation of 25 feet (or 7600 mm) does not apply and the length-to-width ratio of 1.5 is permitted for diaphragms sheathed with single diagonal boards; and a ratio of 2.0 is permitted where sheathed with double diagonal boards or wood structural panels.

2306.4.2.5 Panel height-to-width ratio: The width of a shear panel in a diaphragm or shear wall shall not be less than two feet and the *h/w* ratio of a shear wall shall not be greater than two, where *h* is the height of a shear panel or shear wall an *w* is the width of a shear panel or shear wall.

2306.4.3 Diaphragms: Wood diaphragms shall not be installed to resist torsional forces induced by concrete or masonry construction in buildings of Seismic Performance Category D which are more than two stories in height.

2306.4.3.1 Ties and splices: Diaphragm sheathing shall not be installed as the ties and splices required by 780 CMR 1612.3.6.1.1 and 780 CMR 1612.3.6.1.2.

Exception: Diaphragm sheathing in buildings of Seismic Performance Category C.

2306.4.4 Shear walls: Shear wall construction shall comply with the requirements of 780 CMR 2306.4.4

2306.4.4.1 Design shear increases: The design shear capacity is permitted to be doubled where identical materials are applied to both sides of the wall. Where the shear capacities of the materials are not equal, the allow able shear shall be considered to be equal to either the shear for the side with the higher capacity or twice the shear for the side with the lower capacity.

2306.4.4.2 Material limitations: Shear walls shall be sheathed with wood structural panels in Seismic Performance Category C and D buildings.

Exceptions:

1. **In Seismic Performance Category C buildings**: *particleboard*, gypsum sheathing, gypsum wallboard, fiberboard and wire lath and cement plaster shear walls are permitted.
2. **In Seismic Performance Category D buildings**: *particleboard*, gypsum sheathing, gypsum wallboard and wire lath and cement plaster shear walls in one-story buildings and the top story of buildings two stories or more in height are permitted

2306.4.5 Diagonally sheathed lumber shear panels: Diagonally sheathed lumber shear panels shall be nailed in accordance with Table 2306.4.5.

Table 2306.4.5
DIAGONALLY SHEATHED SHEAR PANEL NAILING SCHEDULE

Sheathing nominal dimension	Nailing to intermediate and end-supported studs		Nailing at the shear panel boundaries	
	Number of nails per board and nail size			
	Common nails	Box nails	Common nails	Box nails
1" x 6"	(2) 8d	(3) 8d	(3) 8d	(5) 8d
1" x 8"	(3) 8d	(4) 8d	(4) 8d	(6) 8d
2" x 6"	(2) 16d	(3) 16d	(3) 16d	(5) 16d
2" x 8"	(3) 16d	(4) 16d	(4) 16d	(6) 16d

2306.4.5.1 Single diagonal construction: Single diagonally sheathed lumber shear panels shall be constructed of minimum one-inch-thick nominal sheathing boards laid at an angle of approximately 45 degrees (0.78 rad) to the supports. The shear capacity for single diagonally sheathed lumber shear panels of Southern pine or Douglas fir-larch shall not exceed 200 pounds per lineal foot (298 kg/m) of width. The shear capacities shall be adjusted by a reduction factor of 0.82 for species with a specific gravity of 0.42 or greater but less than 0.49 and a reduction factor of 0.65 for species with a specific gravity of less than 0.42, as contained in AFPA NDS listed in *Appendix A*.

2306.4.5.1.1 End joints: Joints in adjacent boards shall be separated by not less than one stud or joist space and there shall not be less than two boards between joints on the same support.

2306.4.5.1.2 Two-inch nominal lumber: Wood shear panels made up of two-inch-thick diagonal lumber sheathing fastened with 16d nails shall be designed with the same shear capacities as shear panels using one-inch boards fastened with 8d nails, provided that there are not splices in adjacent boards on the same support and the supports are not less than four inches nominal in depth or three inches nominal in thickness.

2306.4.5.2 Double diagonal construction: Double diagonally sheathed lumber shear panels shall be constructed of two layers of diagonal sheathing boards laid at 90 degrees (1.57 rad) to each other on the same face of the supporting members. Each chord shall be considered as a beam loaded with uniform *load* per foot equal to 50% of the unit shear due to diaphragm action. The *load* shall be assumed as acting normal to the chord in the plane of the diaphragm in either direction. The span of the chord or portion thereof shall be the distance between framing members of the diaphragm such as the joists, studs and blocking that serve to transfer the assumed *load* to the sheathing. The shear capacity of double diagonally sheathed diaphragms of Southern pine or Douglas fir-larch, shall not exceed 600 pounds per lineal foot (893 kg/m) of width. The shear capacity shall be adjusted by a reduction factor of 0.82 for species with a specific gravity of 0.42 or greater but less than 0.49 and a reduction factor of 0.65 for species with a specific gravity of less than 0.42 as contained in AFPA NDS listed in *Appendix A*.

2306.4.6 Wood structural panel shear panels: The design and shear capacity of wood structural panel shear panels shall be in accordance with 780 CMR 2306.4.6.1 for diaphragms and 780 CMR 2306.4.6.2 for shear walls, or shall be calculated by using the nail strengths in AFPA NDS and the wood structural panel shear capacities as given in DOC PS 1 listed in *Appendix A*.

Shear panels shall be constructed of wood structural panels manufactured with exterior glue not less than four feet by eight feet, except at boundaries and changes in framing. Wood structural panels shall be designed to resist shear only, and chords, collector members and boundary members shall be designed to transfer the axial forces. Boundary members shall be connected at all comers. Wood structural panels less than 12 inches (305 mm) wide shall be blocked.

2306.4.6.1 Wood structural panel floor and roof diaphragm construction: The nail size and spacing at diaphragm boundaries and at the edges of each sheet of wood structural panel shall be provided as shown in Table 2306.4.6.1 and Figure 2306.4.6.1, and by the provisions of 780 CMR 2306.4.6.1.1 through 2306.4.6.1.4. Nails of the same size shall be placed along all intermediate framing members at 12 inches (305 mm) on center.

2306.4.6.1.1 Other wood species: Shear capacities for fasteners in framing members of other wood species, shall be calculated by multiplying the shear capacities for Structural I panels by 0.82 for species with a specific gravity of 0.42 and greater but less than 0.49 and 0.65 for species with a specific gravity of less than 0.42. as contained in AFPA NDS listed in *Appendix A*.

2306.4.6.1.2 Framing and panel layout: The orientation of the structural framing and wood structural panels shall comply with Case I,2,3,4,5 or 6 of Table 2306.4.6.1 and with Figure 2306.4.6.1. For blocked diaphragms, the maximum shear for Cases 3, 4, 5 and 6 shall not exceed 1,200 pounds per lineal foot (1787 kg/m).

2306.4.6.1.3 Fastener spacings of two and 2½ inches: Where either two-inch (51 mm) or 2½-inch (64 mm) fastener spacings are installed with two-inch-wide framing members in accordance with Table 2306.4.6.1, the framing member adjoining panel edges shall be three inches nominal in width and nails at panel edges shall be placed in two lines.

2306.4.6.1.4 Panels 1⅛ inch thick: Unblocked 1⅛-inch panels with tongue-and-groove edges are permitted to use the blocked diaphragm shear capacities for 19/32-inch minimum nominal panel thickness values, where one-inch by ⅜-inch crown by No. 16 gage staples are driven through the tongue-and-groove edges ⅜inch (10 mm) from the panel edge so as to penetrate the tongue. Staples shall be spaced at one-half the boundary nail spacing for Cases I and 2 and at ⅓ the boundary nail spacing for Cases 3, 4, 5 and 6.

2306.4.6.2 Wood structural panel shear wall construction: The nail size and spacing at the edge of each wood structural panel shall be provided as shown in Table 2306.4.6.2 and by the provisions of 780 CMR 2306.4.6.2.1 through 2306.4.6.2.3. For ⅜-inch and 7/16-inch panels, installed on studs spaced 24 inches (610 mm) on center, nails shall be spaced at six inches (152 mm) on center along intermediate framing members. For all other thicknesses and spacing of studs, intermediate framing members shall have nails of the same size spaced at 12 inches (305 mm) on center. All panel edges shall be backed with two-inch or wider framing members.

Table 2306.4.6.1
HORIZONTAL WOOD STRUCTURAL PANEL DIAPHRAGM ALLOWABLE SHEAR WITH FRAMING MEMBERS OF DOUGLAS FIR-LARCH OR SOUTHERN PINE

Panel grade	Fastener type	Fastner minimum penetration in framing (inches)	specified panel thickness (inch)	Minimum nominal width of framing member (inches)	Lines of fasteners	Allowable shear (pounds per foot)[b]								
						Blocked diaphragms[a]							Unblocked diaphragms[a]	
						Fastener spacing (inches) at diaphragm boundaries (all cases), at continuous panel edges parallel to load (Cases 3 and 4), and at all panel edges (Cases 5 and 6)							Fastener spacing at 6 inches at supported edges	
						6	4		2½		2		Case 1	Cases 2, 3, 4, 5 and 6
						Spacing (inches) per line at other panel edges (cases 1,2,3 and 4)								
						6	6	4	4	3	3	2		
Structural 1	6d common	1¼	5/16	2	1	185	250		375		420		165	125
				3	1	210	280		420		475		185	140
	8d common	1½	⅜	2	1	270	360		530		600		240	180
				3	1	300	400		600		675		265	200
	10d common	1⅝	15/32	2	1	320	425		640		730		285	215
				3	1	360	480		720		820		320	240
	10d common	1⅝	23/32	3	2		650	870	940	1,230				
				4	2		755	980	1,080	1,410				
				4	3		940	1,305	1,375	1,810				
	14-gage staples	2	23/32	3	2		600	600	840	900	1,040	1,200		
				4	3		840	900	1,140	1,350	1,440	1,800		
C-D, C-C and other similar grades	6d common	1¼	5/16	2	1	170	225		335		380		150	110
				3	1	109	250		380		430		170	125
			⅜	2	1	185	250		375		420		165	125
				3	1	210	280		420		475		185	140
	8d common	1½	⅜	2	1	240	320		480		545		215	160
				3	1	270	360		540		610		240	180
			7/16	2	1	255	340		505		575		230	170
				3	1	285	380		570		645		255	190
			15/32	2	1	270	360		530		600		240	180
				3	1	300	400		600		675		265	200
C-D, C-C and other similar grades	10d common	1⅝	15/32	2	1	290	385		575		655		255	190
				3	1	325	430		650		735		290	215
			19/32	2	1	320	425		640		730		285	215
				3	1	360	480		720		820		320	240
			23/32	3	2		645	870	935	1,225				
				4	2		750	980	1,075	1,395				
				4	3		935	1,305	1,390	1,510				
	14-gage staples	2	23/32	3	2		600	600	820	900	1,020	1,200		
				4	3		820	900	1,120	1,350	1,400	1,510		

Note a. For sheathing and framing configuration Cases 1 through 6, see Figure 2306.4.6.1.

Note b. 1 inch = 25.4 mm; 1 pound per foot = 1.489 jg/m.

Figure 2306.4.6.1
SHEATHING AND FRAMING CONFIGURATIONS

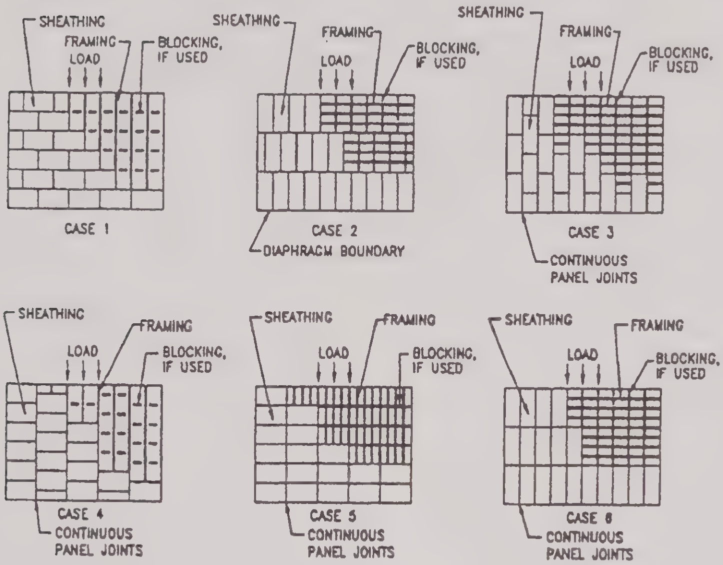

SHEATHING
FRAMING
LOAD
BLOCKING, IF USED
CASE 1
SHEATHING
FRAMING
LOAD
BLOCKING, IF USED
CASE 2
DIAPHRAGM BOUNDARY
SHEATHING
FRAMING
LOAD
BLOCKING, IF USED
CASE 3
CONTINUOUS PANEL JOINTS
SHEATHING
FRAMING
LOAD
BLOCKING, IF USED
CASE 4
CONTINUOUS PANEL JOINTS
SHEATHING
FRAMING
LOAD
BLOCKING, IF USED
CASE 5
CONTINUOUS PANEL JOINTS
SHEATHING
FRAMING
LOAD
BLOCKING, IF USED
CASE 6
CONTINUOUS PANEL JOINTS

Table 2306.4.6.2
ALLOWABLE SHEAR FOR WOOD STRUCTURAL PANEL SHEAR WALLS WITH FRAMING OF DOUGLAS FIR-LARCH OR SOUTHERN PINE FOR WIND OR SEISMIC LOADING

Panel Grade	Minimum nominal panel thickness (inch)	Minimum nail penetration in framing (inches)	Panels applied direct to framing					Panels applied over ½-inch or ⅝-inch gypsum sheathing				
			Nail Size (common or galvanized box)	Allowable shear (pounds per foot)[a] based on nail spacing at panel edges (inches)				Nail size (common or galvanized box)	Allowable shear (pounds per foot)[a] based on nail spacing at panel edges (inches)			
				6	4	3	2		6	4	3	2
Structural I	5/16	1¼	6d	200	300	390	510	8d	200	300	390	510
	⅜	1½	8d	230	360	460	610	10d	280	430	550	730
	7/16			255	395	505	670					
	15/32			280	430	550	730					
	15/32	1⅝	10d	340	510	665	870	-	-	-	-	-
Sheathing, Plywood siding,	5/16	1¼	6d	180	270	350	450	8d	180	270	350	450
	⅜			200	300	390	510		200	300	390	510
	⅜	1½	8d	220	320	410	530	10d	260	380	490	640
	7/16			240	350	450	585					
	15/32			260	380	490	640					
	15/32	1⅝	10d	310	460	600	770	-	-	-	-	-
	19/32			340	510	665	870					
			Nail size (galvanized casing)					Nail size (galvanized casing)				
Plywood siding	5/16	1¼	6d	140	210	275	360	8d	140	210	275	360
	⅜	1½	8d	160	240	310	410	10d	160	240	310	410

Note a. 1 inch = 25.4 mm; 1 pound per foot = 1.489 kg/m.

2306.4.6.2.1 Other wood species: Shear capacities for fasteners in framing members of other wood species shall be calculated by multiplying the shear capacities for Structural I panels by 0.82 for species with a specific gravity of 0.42 or greater but less than 0.49 and 0.65 for species with a specific gravity of less than 0.42, as contained in AFPA NDS listed in ***Appendix A***.

2306.4.6.2.2 Three-inch nominal width framing: Framing shall be three inches nominal or wider and the nails shall be staggered where nails are spaced two inches (51 mm) on center or where 10d nails having a penetration into framing of more than 1⅝ inches (41 mm) are used with a three-inch (76 mm) nail spacing.

2306.4.6.2.3 Panels ⅜ inch and 7/16 inch thick: The shear capacity for ⅜-inch and 7/16-inch panels applied direct to framing with 8d nails is permitted to be increased to the values shown for 15/32-inch panels with the same nailing where the framing studs are spaced a maximum of 16 inches (406 mm) on center or the panels are applied with the long dimension across the studs.

Shear capacity for ⅜-inch and 7/16-inch panels shall be as indicated in Table 2306.4.6.2.

2306.4.7 Particleboard shear panels: The design shear capacity of *particleboard* panels shall be in accordance with 780 CMR 2306.4.7.1 for diaphragms and 780 CMR 2306.4.7.2 for shear walls.

Shear panels shall be constructed with *particleboard* sheets not less than four feet by eight feet, except at boundaries and changes in framing, *particleboard* panels shall be designed to resist shear only, and chords, collector members and boundary members shall be designed to transfer the axial forces. Boundary members shall be connected at all corners. *Particleboard* panels less than 12 inches (305 mm) wide shall be blocked.

2306.4.7.1 Particleboard floor and roof diaphragm construction: The nail size and spacing at diaphragm boundaries and the edges of each sheet of *particleboard* shall be as shown in Figure 2306.4.6.1 and Table 2306.4.7.1 and shall be designed in accordance with the provisions of this section. Nails of the same size shall be placed along all intermediate framing members at 12 inches (305 mm) on center.

2306.4.7.1.1 Other wood species: Shear capacities for fasteners in framing members of other wood species shall be calculated by multiplying the shear capacities by 0.82 for species with a specific gravity of 0.42 or greater but less than 0.49, and by 0.65 for species with a specific gravity of less than 0.42, as contained in AFPA NDS listed in ***Appendix A***.

Table 2306.4.7.1

ALLOWABLE SHEAR FOR PARTICLEBOARD DIAPHRAGMS WITH FRAMING MEMBERS OF DOUGLAS FIR-LARCH OR SOUTHERN PINE FOR SEISMIC LOADING

Panel grade	Common nail size	Minimum nail penetration in framing (inches)	Minimum nominal panel thickness (inch)	Minimum nominal width of framing member (inches)	Allowable shear (pounds per foot)[b]					
					Blocked Diaphragms[a]				Unblocked diaphragms[a]	
					Nail spacing (inches) at diaphragm boundaries (all cases), at continuous panel edges parallel to load (Cases 3 & 4), and all panel edges (Cases 5 & 6)				Nails spaced 6 inches maximum at supported edges	
					6	4	2½	2	Case 1 (No unblocked edges or continuous joints parallel to load)	All other configurations (Cases 2, 3, 4, 5 & 6)
					Nail spacing (inches) at other panel edges (Cases 1, 2, 3 & 4)					
					6	6	4	3		
2-M-W	6d	1¼	5/16	2	170	225	335	380	150	110
				3	190	250	380	430	170	125
			⅜	2	185	250	375	420	165	125
				3	210	280	420	475	185	140
	8d	1½	⅜	2	240	320	480	545	215	160
				3	270	360	540	610	240	180
			7/16	2	255	340	505	575	230	170
				3	285	380	570	645	255	190
			½	2	270	360	530	600	240	180
				3	300	400	600	675	265	200
	10d	1⅝	½	2	290	385	575	655	255	190
				3	325	430	650	735	290	215
			⅝	2	320	425	640	730	285	215
				3	360	480	720	820	320	240
2-M-3	10d	1⅝	¾	2	320	425	640	730	285	215
				3	360	480	720	820	320	240

Note a. For sheathing and framing configuration Cases 1 through 6, see Figure 2306.4.6.1

Note b. 1 inch = 25.4 mm; 1 pound per foot = 1.489 kg/m.

2306.4.7.1.2 Framing and panel layout: The orientation of the structural framing and *particleboard* panels shall comply with Figure 2306.4.6.1 and Case 1, 2, 3, 4,5 or 6 in Table 2306.4.7.1.

2306.4.7.1.3 Fastener spacings of two and 2½ inches: Where either two-inch (51 mm) or 2½-inch (64 mm) fastener spacings are installed with 2-inch-wide framing members in accordance with Table 2306.4.7.1, the framing member adjoining panel edges shall be three inches nominal in width and nails at panel edges shall be placed in two lines.

2306.4.7.1.4 Panel edge framing: Framing at adjoining panel edges shall be three inches nominal or wider and nails shall be staggered where 10d nails having penetration into framing of more than 1⅝ inches (41 mm) are spaced three inches (76 mm) or less on center.

2306.4.7.2 Particleboard shear wall construction: The required nail size and spacing in Table 2306.4.7.2 apply to panel edges only. All panel edges shall be backed with two-inch nominal or wider framing. Sheets are permitted to be installed either horizontally or vertically. For ⅜-inch *particleboard* sheets installed with the long dimension parallel to studs spaced 24 inches (610 mm) on center, nails shall be spaced at six inches (152 mm) on center along intermediate framing members. For all other conditions, nails of the same size shall be spaced at 12 inches (305 mm) on center along intermediate framing members.

2306.4.7.2.1 Other wood species: Shear capacities for fasteners in framing members of other wood species, shall be calculated by multiplying the shear capacities by 0.82 for species with a specific gravity of 0.42 or greater but less than 0.49 and 0.65 for species with a specific gravity of less than 0.42 as contained in AFPA NDS listed in ***Appendix A***.

2306.4.7.2.2 Three-inch nominal width framing: Framing shall be three inches nominal or wider and the nails shall be staggered where nails are spaced two inches (51 mm) on center or where 10d nails having a penetration into framing of more than 1⅝ inches (41 mm) are installed with a three-inch (76 mm) nail spacing.

2306.4.7.2.3 Particleboard of ⅜ and 7/16 inch thicknesses: The shear capacities for ⅜-inch and 7/16-inch *particleboard* applied direct to framing with 8d nails, are permitted to be increased to the ½-inch *particleboard* shear capacities of Table 2306.4.7.2 where the framing studs are spaced a maximum of 16 inches (406 mm) on center or the *particleboard* is applied with the long dimension perpendicular to the studs.

2306.4.7.2.4 Double-sided wall: Where *particleboard* is applied to both faces of a wall and the nail spacing is less than six inches (152 mm) on center on either side, panel joints shall be offset to be placed on different framing members, or framing shall be three inches nominal or thicker and nails on each side shall be staggered.

2306.4.8 Shear panels sheathed with other materials: Wood stud walls sheathed with lath and plaster, gypsum sheathing board or gypsum wallboard, constructed in accordance with 780 CMR 2502.0, or fiberboard sheathing constructed in accordance with 780 CMR 2309.8, shall be permitted to be used to resist earthquake forces in wood frame buildings. Nails shall be spaced at least ⅜ inch (10 mm) from the edges and ends of boards and panels. The maximum height-to-width ratio shall be 1.5. The shear capacities utilized in design shall not be cumulative with the shear capacities of other materials applied to the same wall.

Table 2306.4.7.2
ALLOWABLE SHEAR FOR PARTICLEBOARD SHEAR WALLS WITH FRAMING OF DOUGLAS FIR-LARCH OR SOUTHERN PINE FOR SEISMIC LOADING

Panel grade	Minimum nominal panel thickness (inch)	Minimum nail penetration in framing (inches)	Panels applied direct to framing					Panels applied over ½-inch gypsum sheathing				
			Nail size (common or galvanized box)	Allowable shear (pounds per foot)[a] nail spacing at panel edges (inches)				Nail size (common or galvanized box)	Allowable shear (pounds per foot)[a] nail spacing at panel edges (inches)			
				6	4	3	2		6	4	3	2
2-M-W	5/16	1¼	6d	180	270	350	450	8d	180	270	350	450
	3/8			200	300	390	510		200	300	390	510
	3/8	1½	8d	220	320	410	530	10d	260	380	490	640
	7/16			240	350	450	585					
	½			260	380	490	640					
	½	1⅝	10d	310	460	600	770	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]
	5/8			340	510	665	870					

Note a. 1 inch = 25.4 mm; 1 pound per foot = 1.489kg/m.
Note b. NA = Not Applicable

780 CMR 2307.0 WOOD STRUCTURAL PANELS

2307.1 Standards: All wood structural panels that are utilized structurally shall comply with the requirements of DOC PS 1, DOC PS 2, HPMA HP and HPMA HP-SG listed in ***Appendix A*** for the type, grade and span rating or species group of wood structural panels involved, and shall be so identified by an *approved agency*.

2307.2 Types: Wood structural panels for interior installations shall be of the interior type, moisture-resistant type or exterior type. Wood structural panels for exterior installations shall be of the exterior-waterproof type, except that wood structural panel roof sheathing exposed to the outdoors on the underside is permitted to be of the interior type and bonded with exterior glue. Exterior wood structural panels shall not be applied directly to the framing as a siding unless the wood structural panel has a minimum nominal thickness of ⅜ inch. Joints shall occur over framing members, unless wood or wood structural panel sheathing is used or joints are lapped horizontally a minimum of 1½ inches (38 mm) or otherwise made waterproof in an approved manner. Where a wood structural panel is utilized as lapped siding without sheathing, the wall framing to which such wood structural panel is attached shall be diagonally braced.

23073 Spans: The maximum spans for wood structural panel sheathing shall be limited by the allowable stresses and deflections for the design *live load*, but shall not be greater than the spans specified in Tables 2307.3.1(1), 2307.3.1(2), 2307.3.3 and 2307.3.5. The spans specified in these tables shall apply to wood structural panels not treated with fire retardant chemicals. The design criteria for fire retardant-treated wood structural panels shall be provided by valid research reports from approved sources.

2307.3.1 Floor and roof sheathing: Allowable spans for floor and roof sheathing shall be as specified in Tables 2307.3.1(1) and 2307.3.1(2). The values in Table 2307.3.1(1) apply to Structural I, C-D and C-C sheathing and single floor grades only, and are limited to the spans shown because of the possible effects of concentrated *loads*.

2307.3.2 Floor sheathing: Edges of wood structural panel floor sheathing shall have approved tongue-and-groove joints or shall be supported with blocking, unless ¼-inch minimum thickness underlayment or 1½ inches (38 mm) of approved cellular or lightweight concrete is installed, or unless the finish floor is of ¾-inch wood strip. The allowable uniform *load* based on a deflection of 1/360 of the span is 100 pounds per square foot (psf) (488 kg/m^2) at maximum span.

2307.3.3 Wood structural panel combination subfloor underlayment: Allowable spans for combination subfloor underlayment shall be as specified in Table 2307.3.3.

Table 2307.3.1(1)

ALLOWABLE SPANS AND LOADS FOR WOOD STRUCTURAL PANEL SHEATHING GRADES AND SINGLE FLOOR GRADES CONTINUOUS OVER TWO OR MORE SPANS WITH LONG DIMENSION PERPENDICULAR TO SUPPORTS[a,b,g]

Sheathing grades		Roof				Floor
Span rating[h]	Panel thickness (inch)[i]	Maximum span (inches)[i]		Load (pounds per square foot)[i]		Maximum span (inches)[f]
Roof/floor span		With edge support[c]	Without edge support	Total load	Live load	
12/0	5/16	12	12	40	30	0
16/0	5/16, ⅜	16	16	40	30	0
20/0	5/16, ⅜	20	20	40	30	0
24/0	⅜, 7/16, ½	24	20[d]	40	30	0
24/16	7/16, ½	24	24	50	40	16
32/16	15/32, ½, ⅝	32	28	40	30	16[f]
40/20	23/32, ⅝, ¾, ⅞	40	32	40	30	20[e,f]
48/24	23/32, ¾, ⅞	48	36	45	35	24
Single floor grades		**Roof**				**Floor**
Span rating[h]	Panel thickness (inches)[i]	Maximum span (inches)[i]		Load (pounds per square foot)[i]		Maximum span (inches)[f]
		With edge support[c]	Without edge support	Total load	Live load	
16 o.c.	19/32, ⅝	24	24	50	40	16[f]
20 o.c.	19/32, ⅝, ¾	32	32	40	30	20[e,f]
24 o.c.	23/32, ¾	48	36	35	25	24
32 o.c.	⅞, 1	48	40	50	40	32
48 o.c.	1 3/32, 1⅛	60	48	50	40	48

Note a. The allowable loads were determined based on a dead load of 10 psf. If the dead load exceeds 10 psf, then the live load shall be reduced accordingly.

Note b. For limitations on the applicability of this table to wood structural panel grade, see 780 CMR 2307.3.1

Note c. Tongue-and-groove edges, panel edge clips (one midway between each support, except two equally spaced between supports 48 inches on center), lumber blocking, or other. Only lumber blocking shall satisfy blocked diaphragm requirements.

Note d. 24 inches for ½-inch panels.

Note e. Maximum framing space shall be 24 inches on center for floors where 1½ inches of cellular or lightweight concrete is applied over the panels.

Note f. Maximum frame spacing shall be 24 inches on center where ¾-inch wood strip flooring is installed a right angles to joist.

Note g. Shall apply only to panels 24 inches or wider.

Note h. Span rating shall appear on all panels in the construction grades listed in 780 CMR 2307.3.1.

Note i. 1 inch = 25.4 mm; 1 psf = 4.882 kg/m^2.

Table 2307.3.1(2)

ALLOWABLE LOADS FOR WOOD STRUCTURAL PANEL ROOF SHEATHING CONTINUOUS OVER TWO OR MORE SPANS AND LONG DIMENSION PARALLEL TO SUPPORTS

(Plywood Structural Panels are 5 ply/5 layer unless otherwise noted)[a]

Panel grade	Thickness (inch)[c]	Span rating	Maximum span (inch)[c]	Load at maximum span (psf)[c]	
				Live	Total
Structural I sheathing	7/16	24/0, 24/16	24	20	30
	15/32	32/16	24	35[b]	45[b]
	½	32/16	24	40[b]	50[b]
	19/32, ⅝	40/20	24	70	80
	23/32, ¾	48/24	24	90	100
Sheathing	7/16	24/0, 24/16	16	40	50
	15/32	32/16	24	20	25
	½	24/0, 32/16	24	25	30
	19/32	40/20	24	40[b]	50[b]
	⅝	32/16, 40/20	24	45[b]	55[b]
	23/32, ¾	40/20, 48/24	24	60[b]	65[b]

Note a. Uniform load deflection limitations: 1/180 of span under live load plus dead load, 1/240 under live load only. Edges shall be blocked with lumber or other approved type of edge supports.
Note b. For composite and 4-ply plywood panels, load shall be reduced by 15 psf.
Note c. 1 inch = 25.4 mm; 1 psf = 4.882 kg/m .

Table 2307.3.3
ALLOWABLE SPANS FOR WOOD STRUCTURAL PANEL COMBINATION SUBFLOOR UNDERLAYMENT[a] PANELS CONTINUOUS OVER TWO OR MORE SPANS AND LONG PANEL DIMENSION PERPENDICULAR TO SUPPORT (THICKNESS IN INCHES)[d]

Identification	Maximum spacing of joists (inches)				
Species groups[b]	16	20	24	32	48
1	½	⅝	¾	-	-
2,3	⅝	¾	⅞	-	-
4	¾	⅞	1	-	-
Single floor span rating[c]	16 o.c.	20 o.c.	24 o.c.	32 o.c.	48 o.c.

Note a. For limitations on the use of Table 2307.3.3 see 780 CMR 2307.3.4.
Note b. Applicable to all grades of sanded exterior-type plywood.
Note c. Applicable to underlayment grade and C-C (plugged) plywood and single-floor grade panels.
Note d. 1 inch = 25.4 mm; 1 psf = 4.882 kg/m^2.

2307.3.4 Limitations: Table 2307.3.3 is applicable to under layment grade, C-C (plugged), single-floor grade and all grades of sanded exterior-type plywood. For panels with a span rating of other than 48 inches (1219 mm) on center (o.c.), the allowable uniform *load* based on a deflection of 1/360 of the span is 100 psf (488 kg/m^2). Panels with a span rating of 48 inches o.c. are limited to a total *load* of 65 psf (317 kg/m^2) at the maximum span. Wood structural panel edges shall have approved tongue-and-groove joints or shall be supported with blocking, unless ¼-inch minimum thickness underlayment or 1½ inches (38 mm) of approved cellular or lightweight concrete is installed, or unless the finish floor is of ¾-inch wood strip. If wood strips are perpendicular to the supports, thicknesses or span ratings shown for 16-inch (406 mm) and 20-inch (508 mm) spans shall be used on 24-inch (610 mm) spans. Spans are limited to the values shown in Table 2307.3.3 because of the possible effects of concentrated *loads*.

2307.3.5 Vertical maximum stud spacing: Stud spacing for vertical sheathing shall be as specified in Table 2307.3.5.

Table 2307.3.5
ALLOWABLE STUD SPACING FOR WOOD STRUCTURAL PANEL WALL SHEATHING

Panel span rating	Panel thickness (inch)[d] and construction	Maximum stud spacing (inches)[d] Exterior coverings nailed to:[a]	
		Stud	Sheathing
12/0, 16/0, 20/0 or wall - 16 o.c.	5/16, ⅜	16	16[b]
24/0, 24/16, 32/16 or wall - 24 o.c.	⅜, 7/16, 15/32, ½	24	24[c]

Note a. Blocking of horizontal joints shall not be required.
Note b. Plywood sheathing ⅜ inch thick or less shall be applied with long dimension across studs.
Note c. Three-ply plywood panels shall be applied with long dimension across studs.
Note d. 1 inch = 25.4 mm.

2307.4 Stressed skin panel: For use in stressed skin or other prefabricated construction, wood structural panel design shall be determined by approved engineering analysis or by the tests prescribed in 780 CMR 1710.0 for prefabricated assemblies.

780 CMR 2308.0 PARTICLEBOARD

2308.1 Standards: *Particleboard* shall conform to ANSI A208.1 listed in ***Appendix A***. *Particleboard* shall be identified by the grade mark or the certificate of inspection issued by an *approved agency*.

2308.2 Floor underlayment: Underlayment shall conform to Type l-M-l or sanded Type 2-M-W of ANSI A208.1 listed in ***Appendix A***. Underlayment shall not be less than ¼ inch in thickness and shall be installed in accordance with the manufacturer's installation instructions.

2308.3 Subfloor or combination subfloor underlayment: Allowable spans and grades for combination subfloor underlayment shall be as specified in Table 2308.3. All panels shall be continuous over two or more spans and the tongue-and-groove panels shall be installed with the long dimension perpendicular to the supports. Uniform deflection limitation shall be 1/360 of the span under a minimum *load* of 100 psf. Edges shall have tongue-and-groove joints or shall be supported with blocking unless ¼-inch minimum thickness underlayment is installed, or unless the finish floor is of 25/32-inch wood strip.

Table 2308.3
ALLOWABLE SPANS FOR PARTICLEBOARD SUBFLOOR AND COMBINATION SUBFLOOR UNDERLAYMENT[a]

Grade	Thickness (inches)	Maximum spacing[b] of supports (inches)	
		Subfloor	Combination subfloor underlayment
2-M-W	½	16	-
	⅝	20	16
	¾	24	24
2-M-3	¾	20	20

Note a. For limitations on the use of Table 2308.3, see 780 CMR 2308.3
Note b. 1 inch = 25.4 mm.

2308.4 Roof sheathing: Allowable *loads* for roof sheathing shall be in accordance with the spans and grades specified in Table 2308.4. Panels shall be continuous over two or more spans. Uniform *load* deflection limitations shall be 1/180 of the span under *live load* plus *dead load* and 1/240 of the span under *live load* only. Edges of all ⅜-inch panels and edges of 7/16-inch panels with 24 inches (610 mm) o.c. spacing shall be supported with blocking or edge clips.

Table 2308.4
ALLOWABLE LIVE LOADS FOR PARTICLEBOARD ROOF SHEATHING[a,b]

Grade	Thickness (inches)	Maximum on-center spacing of supports (inches)	Live load (pounds per square foot)	Total load (pounds per square foot)
2-M-W	⅜	16	45	65
	7/16	16	105	105
	7/16	24	30	40
	½	16	110	150
	½	24	40	55

Note a. For limitations on the use of Table 2308.4, see 780 CMR 2308.4.
Note b. 1 inch = 25.4 mm; 1 pound per square foot = 4.882 kg/m^2.

2308.5 Siding and sheathing: Allowable spans and grades of *particleboard* siding and sheathing shall be as specified in Tables 2308.5(1) and 2308.5(2).

Table 2308.5(1)
ALLOWABLE SPANS FOR EXPOSED PARTICLEBOARD PANEL SIDING

Grade	Stud spacing (inches)	Minimum thickness (inches)		
		Siding		Exterior ceilings and soffits
		Direct to studs	Continuous support	Direct to supports
2-M-W	16	⅜	5/16	5/16
	24	½	5/16	⅜
2-M-1 and 2-M-2	16	⅝	⅜	-
	24	¾	⅜	-

Note a. 1 inch = 25.4 mm.

Table 2308.5(2)
ALLOWABLE SPANS FOR PARTICLEBOARD WALL SHEATHING[a]

Grade	Thickness (inches)	Stud spacing (inches)[b]	
		Siding nailed to studs	Sheathing under coverings parallel or perpendicular to studs
2-M-W	5/16	16	-
	⅜	24	16
	7/16	24	24
2-M-1 and 2-M-2	⅜	16	-
	½	16	16

Note a. Where not exposed to the weather and where the long dimension of the panel is parallel or perpendicular to the studs.
Note b. 1 inch = 25.4 mm.

780 CMR 2309.0 FIBERBOARD

2309.1 Standards: Insulating boards manufactured with wood or other vegetable fibers which are used as building boards for sheathing, roof decks, interior wall and ceiling finishes, roof insulation or sound deadening, shall be vermin-proof, resistant to rot-producing fungi, water-repellent and shall conform to the strength and durability tests specified in ASTM C208 and C532 and AHA A 194.1 listed in *Appendix A*. Sheathing that is utilized structurally shall be so identified by an *approved agency*. Where required under the provisions of 780 CMR 7 or 8, the boards shall be *protected* or treated to develop the required fireresistance rating or flameresistance as determined by test.

2309.2 Jointing: To insure tight-fitting assemblies, edges shall be manufactured with square, shiplapped, beveled, tongue-and-groove or U-shaped joints.

2309.3 Roof insulation: Where used as roof insulation in all types of construction, fiberboards shall be *protected* with an approved roof covering.

2309.4 Wall insulation: Where installed and *firestopped* to comply with 780 CMR 7, fiberboards are permitted as wall insulation in all types of construction. In *fire wall* and *fire separation wall* constructions, unless treated to comply with 780 CMR 803.2 for Class 1 materials, the boards shall be cemented directly to the masonry or other noncombustible base and shall be protected with an approved noncombustible veneer anchored to the base without intervening air spaces.

2309.5 Drywall construction: Where fireresistance ratings are required, provision shall be made for interlocking, lapping or otherwise protecting the joints between adjacent boards to insure smoke and flame tightness.

2309.6 Insulating roof deck: Where used as roof decking in open beam construction, fiberboard insulating roof deck shall have a nominal thickness of not less than one inch.

2309.7 Siding: Hardboard siding shall comply with AHA A135.6 listed in ***Appendix A***.

2309.8 Shear capacity: Wood stud walls sheathed with fiberboard sheathing are permitted to resist horizontal *loads* provided that such walls comply with Table 2309.8. Fiberboard shear walls shall not be utilized to resist horizontal *loads* from concrete or masonry walls.

Table 2309.8
ALLOWABLE SHEAR CAPACITY FOR WIND OR SEISMIC LOADING ON SHEAR WALLS OF FIBERBOARD SHEATHING BOARD

Thickness and grade	Fastener type[a]	Shear capacity for 3-inch nail spacing around perimeter and 6-inch at intermediate studs (pounds per foot of wall)[b,c]
½-inch Regular density	No. 11 ga. galv. Roofing nail 1½" long 7/16"head	50
½-inch Intermediate density	No. 11 ga. galv. Roofing nail 1½" long 7/16"head	60
25/32-inch Regular density	No. 11 ga. galv. Roofing nail 1¾" long 7/16"head	60

Note a. Fiberboard sheathing is permitted to be stapled using 16-gage galvanized staples 1⅛ inch long for ½-inch sheathing and 1½ inch long for 25/32-inch sheathing. Staples shall have a minimum crown of 7/16 inch and shall be spaced three inches o.c. at edges and six inches o.c. at studs.

Note b. Where studs are permitted to be located at 24 inches o.c., the shear capacity shall not be greater than 50 pounds per linear foot (plf).

Note c. 1 inch = 25.4 mm: 1 plf = 1.489 kg/m.

2309.8.1 Framing: Four-foot by eight-foot fiberboard sheathing shall be applied vertically to wood studs not less than two inches nominal in thickness spaced 16 inches (406 mm) on center.

Exception: Studs on 24-inch centers are permitted for ½-inch intermediate density sheathing and 25/32-inch regular density sheathing in accordance with Table 2309.8.

2309.8.2 Nailing: Nailing shall be in accordance with Table 2309.8. Nails shall be spaced not less than ⅜ inch (10 mm) from edges and ends of sheathing.

780 CMR 2310.0 FIRERETARDANT-TREATED WOOD

2310.1 Applications: Fireretardant-treated wood shall comply with 780 CMR 2310.0. Where Table 602 permits fireretardant-treated wood in Types 1 and 2 construction, fireretardant-treated wood shall not be utilized in loadbearing walls or in assemblies with a required fireresistance rating of more than one hour.

2310.2 General: Fireretardant-treated wood shall be any wood product which, when impregnated with chemicals by a pressure process in accordance with AWPA C20 or AWPA C27 listed in ***Appendix A***, or other means during manufacture, shall have, when tested in accordance with ASTM E84 listed in ***Appendix A***, a flame spread rating not greater than 25 when the test is continued for a period of 30 minutes, without evidence of significant progressive combustion; and the flame front shall not progress more than 10½ feet (3048 mm) beyond the centerline of the burner at any time during the test. Fireretardant-treated wood shall be dried to a moisture content of 19% or less for lumber and 15% or less for plywood before use.

2310.2.1 Strength modifications: Design values for untreated lumber, as specified in 780 CMR 2303.1, shall be adjusted for lumber that is pressure impregnated with fireretardant chemicals. Adjustments to the design values shall be based upon an approved method of investigation which takes into consideration the effects of the anticipated temperature and humidity to which the fireretardant-treated wood will be subjected, the type of treatment and redrying procedures.

2310.2.2 Labeling: Fireretardant-treated lumber and plywood shall bear the *label* of *approved agencies* in accordance with 780 CMR 1704.3.2. Such *labels* shall indicate compliance with the appropriate treating standard in accordance with 780 CMR 2310.2 and indicate compliance with 780 CMR 2310.2.1.

2310.3 Exposure to weather: Where fireretardant-treated wood is to be exposed to the weather, the material shall be further identified to indicate that there is not an increase in the listed flame spread classification after being weathered in accordance with ASTM D2898 listed in ***Appendix A***. Fireretardant-treated wood subjected to high-humidity conditions shall be identified to indicate that the treated wood has a moisture content of not over 28% when tested at 92% relative humidity in accordance with ASTM D3201 listed in ***Appendix A***.

780 CMR 2311.0 NATURALLY DURABLE AND PRESERVATIVE-TREATED WOOD

2311.1 Required: Where protection of wood members is required because of exposure to soil or weather, protection shall be provided by using naturally durable or *preservative-treated* wood as required by 780 CMR 2311.0.

2311.2 Naturally durable wood: The term "naturally durable wood" refers to the heartwood of the following species with the exception that an occasional piece with corner sapwood is permitted if 90% or more of the width of each side on which it occurs is heartwood

Decay resistant:	Redwood, cedar, black locust and black walnut.
Termite resistant:	Redwood and Eastern red cedar

2311.3 Preservative-treated wood: The term "*preservative-treated* wood" refers to wood (including plywood) pressure treated with preservatives, that conforms to retention, penetration and other requirements applicable to the species, product, treatment and conditions of use in AWPA C 1, C2 and C9 listed in *Appendix A*. Preservatives shall conform to AWPA P1/P13, P2, P5, P8 and P9 listed in *Appendix A*. Lumber and plywood in wood foundation systems shall conform to 780 CMR 1808.3.

2311.3.1 Identification: All piles, poles, lumber and plywood which are required to be *preservative-treated* shall bear the quality mark of an *approved agency* that maintains continuing supervision, testing and inspection over the quality of the product. Quality-control inspection agencies for *preservative-treated* wood shall be certified as to competency and performance by an approved organization. Said mark shall include the following information in a legible format: identification of the inspection agency; the standard to which the product is treated; the identification of the treating plant; and the purpose for which the product has been treated. The mark shall be permanently affixed to each piece unless specifically waived by the code official.

2311.3.2 Moisture content: Where wood that is pressure treated with a water-borne *preservative* is used in enclosed locations where drying in service cannot readily occur, such wood shall be at a moisture content of 19% or less before being covered with insulation, interior wall finish, floor covering or other material.

2311.3.3 Fasteners: Fasteners for *preservative-treated* wood shall be of hot-dipped, zinc-coated, galvanized stainless steel, silicon bronze, copper or other corrosion-resistant materials. Fasteners for wood foundations shall be as required in AFPA TR7 listed in *Appendix A*.

2311.4 Wood used above ground: Wood installed above ground in the locations specified in 780 CMR 2311.4.1 through 2311.4.6 shall be naturally durable wood or *preservative-treated* wood that uses water-borne preservatives, and shall be treated in accordance with AWPA C2 or C9 listed in *Appendix A* for above-ground use.

2311.4.1 Joists and girders: Where wood joists or the bottom of a wood structural floor without joists are closer than 18 inches (457 mm), or wood girders are closer than 12 inches (305 mm), to the exposed ground in crawl spaces or unexcavated areas located within the perimeter of the building foundation, the floor assembly (including posts, girders, joists and subfloor) shall be of approved naturally durable or *preservative-treated* wood.

2311.4.2 Framing: All wood framing members, including wood sheathing, which rest on exterior foundation walls and are less than eight inches (203 mm) from exposed earth shall be of approved naturally durable or *preservative-treated* wood.

2311.4.3 Sleepers and sills: Sleepers and sills on a concrete or masonry slab which is in direct contact with earth shall be of approved naturally durable or *preservative-treated* wood.

2311.4.4 Girder ends: The ends of wood girders entering exterior masonry or concrete walls shall be provided with a ½-inch (13 mm) air space on top, sides and end, unless approved naturally durable or *preservative-treated* wood is used.

2311.4.5 Clearance: Clearance between wood siding and earth on the exterior of a building shall not be less than six inches (152 mm) except where siding, sheathing and wall framing are of approved *preservative-treated* wood.

← SILLS
ABOVE
GROUND

2311.4.6 Posts or columns: Posts or columns supporting permanent structures and supported by a concrete or masonry slab or footing which is in direct contact with the earth shall be of approved naturally durable or *preservative-treated* wood

Exceptions:

1. Posts or columns which are either exposed to the weather or located in *basements* or cellars, supported by concrete piers or metal pedestals projecting at least one inch (25 mm) above the slab or deck and six inches (152 mm) above exposed earth, and are separated therefrom by an impervious moisture barrier.
2. Posts or columns in enclosed crawl spaces or unexcavated areas located within the periphery of the building, supported by a concrete pier or metal pedestal at a height greater than eight inches (203 mm) from

exposed ground, and are separated therefrom by an impervious moisture barrier.

2311.5 Wood in contact with the ground: All wood in contact with the ground (exposed earth) which supports permanent structures that are intended for human occupancy, shall be of approved naturally durable or *preservative-treated* wood using water-borne *preservatives* and shall be treated in accordance with AWPA C2 or C9 listed in *Appendix A* for ground contact, where used in the locations specified in 780 CMR 2311.5.1 and 2311.5.2.

Exception: Untreated wood is permitted where such wood is entirely below the ground water level or where continuously submerged in fresh water.

2311.5.1 Posts or columns: Sawn posts and columns supporting permanent structures that are intended for human occupancy and which are embedded in concrete in direct contact with the earth or embedded in concrete exposed to the weather, or in direct contact with the earth, shall be of approved *preservative-treated* wood.

2311.5.2 Wood structural members: Wood structural members that support moisture-permeable floors or roofs which are exposed to the weather - such as concrete or masonry slabs - shall be of approved naturally durable or *preservative-treated* wood unless separated from such floors or roofs by an impervious moisture barrier.

2311.6 Geographical areas: In geographical areas where experience has demonstrated a specific need, approved naturally durable or *preservative-treated* wood shall be utilized for those portions of wood members which form the structural supports of buildings, balconies, porches or similar permanent building appurtenances where such members are exposed to the weather without adequate protection from a roof, eave, overhang or other covering to prevent moisture or water accumulation on the surface or at joints between members. Depending on local experience, such members include, but are not limited to, the following:

1. Horizontal members such as girders, joists and decking;
2. Vertical members such as posts, poles and columns; or
3. Both horizontal and vertical members.

2311.7 Wood used in retaining walls: Wood installed in retaining or crib walls shall be of approved *preservative-treated* wood treated in accordance with AWPA C2 or C9 listed in *Appendix A* for ground contact, except as indicated in 780 CMR 2311.7.1 through 2311.7.3.

2311.7.1 Untreated wood: Where the wall is not more than two feet (610 mm) in height and is separated from the *lot line* or a permanent building by a minimum distance equal to the height of the wall, the wall is permitted to be of untreated wood.

2311.7.2 Naturally durable wood on the lot line: Where a retaining wall or a crib wall is not more than two feet (610 mm) in height and is located on the *lot line*, approved naturally durable wood is permitted.

2311.7.3 Naturally durable wood separated: Where a retaining wall or a crib wall is not more than four feet (1219 mm) in height and is separated from the *lot line* or a permanent building by a minimum distance equal to the height of the wall, approved naturally durable wood is permitted.

780 CMR 2312.0 JOIST HANGERS

2312.1 Test standard: The vertical loadbearing capacity, torsional moment capacity, and deflection characteristics of joist hangers shall be determined in accordance with ASTM D1761 listed in *Appendix A*, using lumber having a specific gravity of 0.49 or greater but not greater than 0.55 as determined in accordance with AFPA NDS listed in *Appendix A* for the joist and headers.

2312.2 Vertical load capacity: The vertical *load* capacity for the joist hanger shall be determined by testing three joist hanger assemblies as specified in ASTM D1761 listed in *Appendix A*. If the ultimate vertical *load* for any one of the tests varies more than 20% from the average ultimate vertical *load*, at least three additional tests shall be conducted. The allowable vertical *load* for a normal *duration of loading* of the joist hanger shall be the lowest value determined from the following:

1. The lowest ultimate vertical *load* from any test divided by 2.5 (where three tests are conducted and each ultimate vertical *load* does not vary more than 20% from the average ultimate vertical *load*).
2. The average ultimate vertical *load* for all tests divided by six (where six tests are conducted).
3. The vertical *load* at which the vertical movement of the joist with respect to the header is 0.125 inch (3 mm) in any test.
4. The allowable design *load* for nails or other fasteners utilized to secure the joist hanger to the wood members.
5. The allowable design *load* for the wood members forming the connection.

2312.3 Torsional moment capacity: The torsional moment capacity for the joist hanger shall be determined by testing at least three joist hanger assemblies as specified in ASTM D1761 listed in *Appendix A*. The allowable torsional moment for normal *duration of loading* of the joist hanger shall be the average torsional moment at which the lateral movement of the top or bottom of the joist with respect to the original position of the joist is 0.125 inch.

2312.4 Design value modifications: Allowable design values for joist hangers which are determined by failure of the metal-to-wood connection shall be permitted to be modified by the appropriate *duration of loading* factors as specified in AFPA NDS listed in *Appendix A*. Allowable design values determined by failure of the metal joist hanger shall not be modified by *duration of loading* factors.

780 CMR 2313.0 PREFABRICATED COMPONENTS

2313.1 Structural glued-laminated members: Buildings and structures designed and erected of glued-laminated structural members or of composite members of dimension lumber and wood structural panels shall comply with 780 CMR 2313.0.

2313.1.1 Exposed structural glued-laminated timber: Those portions of glued-laminated timbers which form the structural supports of a building or other structure and are exposed to weather and not properly protected by a roof, eave overhang or similar covering, shall be treated in accordance with AITC 109 listed in *Appendix A* or shall be manufactured from approved naturally durable woods.

2313.1.2 Glued-laminated members: Design and fabrication of built-up beam and column sections, which consist of one or more webs with glued-lumber flanges and stiffeners, shall be based upon an approved method which takes into consideration the conditions of use. Glued-laminated elements shall be subject to a quality control program administered by an *approved agency* and shall bear a *label* in accordance with 780 CMR 1704.3. Such *label* shall contain the information required by 780 CMR 1704.3.3.

2313.1.3 Gluing surfaces: In glued-lumber constructions, the surfaces to be glued shall be worked to a smooth, flat surface without sanding and shall be free from wax, grease or oil to insure a complete glue bond over the entire contact. Factory-sanded wood structural panels shall be permitted.

2313.2 Sandwich panels: Design and fabrication of sandwich panels or other integrated assemblies which are fabricated of dimension lumber with wood stress coverings glued thereto, or which consist of structural units of metal-covered or molded wood structural panels or other approved plastics formed and molded into prefabricated loadbearing members, shall be based upon an approved method which takes into consideration the conditions of installation or meets the test requirements of 780 CMR 1704.0, 1709.0 and 1710.0. Sandwich panels shall be subject to a quality control program administered by an *approved agency* and shall bear a *label* in accordance with 780 CMR 1704.3. Such *label* shall contain the information required by 780 CMR 1704.3.3

2313.2.1 Splices: Splices and connections between panels shall be weather tight and shall be of sufficient strength to resist two and one-half times the design *live load* to which such splices will be subjected in normal installation. The fastening of coverings to structural studs, ribs or joists shall provide a rigidity equivalent to approved gluing. Nailing shall not be acceptable for that purpose.

2313.3 Prefabricated trusses: Prefabricated trusses shall be designed to resist all superimposed design *loads*.

2313.3.1 Roof trusses: Metal-plate-connected roof trusses shall be designed in accordance with TPI *Design Specifications for Metal Plate Connected Wood Trusses* and AFPA NDS listed in *Appendix A*, and shall be braced to prevent rotation and provide lateral stability.

2313.3.2 Floor trusses: Metal-plate-connected floor trusses shall be designed in accordance with TPI *Design Specifications for Metal Plate Connected Parallel Chord Wood Trusses* and AFPA NDS listed in *Appendix A*.

2313.4 Special inspection: The fabrication process for prefabricated wood components shall be subject to *special inspection* as required by 780 CMR 1705.4.

2313.5 Prefabricated wood I-joists: Structural capacities and design provisions for prefabricated wood I joists shall be established and monitored in accordance with ASTM D5055 listed in *Appendix A*.

NON-TEXT PAGE

CHAPTER 24

GLASS AND GLAZING

780 CMR 2401.0 GENERAL

2401.1 Scope: The provisions of 780 CMR 24 shall govern the materials, design, construction and quality of glass and glazing in vertical and sloped applications. For the definition of approved light-transmitting plastic, see 780 CMR 2604.1. ***Safety glazing materials shall conform to the requirements of M.G.L. c. 143, §§ 3T, 3U, and 3V, as amended and CPSC 16 CFR; 1201, as applicable.***

780 CMR 2402.0 GENERAL REQUIREMENTS FOR GLASS

2402.1 Marking: Each *lite* shall bear the manufacturer's mark designating the type and thickness of glass. The mark shall not be omitted unless approved and an affidavit is furnished by the glazing contractor certifying that each *lite* is glazed in accordance with approved plans and specifications in accordance with the provisions of 780 CMR 24. Safety glazing shall be marked in accordance with 780 CMR 2405.1.1 ***and shall conform to the requirements of M.G.L. c. 143, §§ 3T, 3U, and 3V, as amended.*** The mark shall not be omitted from tempered glass. Each unit of tempered glass shall be permanently identified by the manufacturer's mark. The identifying mark shall be etched or ceramic fired on the glass and shall be visible when the unit is glazed. Tempered spandrel glass is exempted from permanent marking, but shall be provided with a removable paper marking by the manufacturer.

2402.2 Glass supports: Where one or more sides of any *lite* of glass is not firmly supported, or is subjected to unusual *load* conditions, detailed *construction documents*, detailed shop drawings and analysis or test data assuring safe performance for the specific installation shall be prepared by a *registered design professional* and approved. Analysis shall be based on the *wind loads* required by 780 CMR 1611.6. The elevation of the glazed openings shall be computed by adding the distances from grade to the head and sill, respectively, and dividing the sum by two.

2402.3 Interior glazed areas: Where interior glazing is installed adjacent to a walking surface, the differential deflection of two adjacent unsupported edges shall not be greater than the thickness of the panels when a force of 50 pounds per linear foot (730 N/m) is applied horizontally to one panel at any point up to 42 inches (1067 mm) above the walking surface.

2402.4 Glass dimensional tolerance: Glass thickness tolerances shall comply with those established in Table 2402.4. Where the thickness is to be controlled, nominal values are stated subject to the tolerances shown in Table 2402.4.

Table 2402.4
MINIMUM GLASS THICKNESS

Nominal thickness (inches)	Plate glass minimum thickness (inches)[a]	Sheet glass minimum thickness (inches)[a]
Single strength (SS)	—	0.085
Double strength (DS)	—	0.115
1/8	0.094	—
3/16	0.156	0.182
13/64	0.172	—
7/32	—	0.205
1/4	0.218	0.236
5/16	0.281	—
3/8	0.343	0.357
1/2	0.468	0.478
5/8	0.562	—
3/4	0.689	—
7/8	0.750	—
1	0.875	—
1 1/4	1.125	—

Note a. One inch = 25.4 mm.

2402.5 Louvered windows or jalousies: Regular float, wired and patterned glass in louvered windows and jalousies shall not be thinner than nominal 3/16 inch and not longer than 48 inches (1219 mm). Where other glass types are used, design shall be submitted to the code official for approval. Exposed glass edges shall be smooth. Wired glass with wire exposed on longitudinal edges shall not be used in jalousies or louvered windows.

780 CMR 2403.0 WIND, SNOW AND DEAD LOADS ON GLASS

2403.1 Vertical glass: All glass within 15 degrees (0.26 rad) of vertical in windows, curtain and window walls, doors and other exterior applications shall be designed to resist the *wind loads* in 780 CMR 1611.6 for components and cladding. Maximum allowable sizes shall be based on Figure 2403.1. The equivalent *load* for use in the figure shall be determined by dividing the design *wind load* by the applicable factor from Table 2403.1. Figure 2403.1 is for rectangular glass firmly supported on all four edges.

2403.2 Sloped glass: All glass sloped more than 15 degrees (0.26 rad) from vertical in skylights, sunspaces, sloped roofs and other exterior applications shall be designed to resist the combination of *wind loads* in 780 CMR 1611.6 for components and cladding, the snow *loads* in 780 CMR 1610.0, and the glass *dead load*. Maximum allowable sizes shall be based on Figure 2403.1. Figure 2403.1 is for rectangular glass firmly supported on all four edges.

The combined *load* shall be calculated as follows. The largest of 1, 2 or 3 shall be used:

1. Negative *wind load; - F* x *dead load*
2. Positive *wind load; + F* x *(dead load + ½ wind load)*
3. *F* x *(snow load + dead load) + ½* positive *wind load*

where:

F = 2.0 where any pane or ply is regular glass.

F = 1.5 where any pane or ply is heat-strengthened glass and the remainder are fully tempered glass.

F = 1.2 where all panes and plies are fully tempered glass.

The glass *dead load* is equal to the cosine of the slope from horizontal x the total glass thickness in inches x 13.

The equivalent *load* for use in Figure 2403.1 shall be determined by dividing the combined load by the applicable factor from Table 2403.2.

Table 2403.1
FACTORS FOR VERTICAL GLASS

Glass type	Factor for use with figure 2403.1
Single Glass	
Regualr (annealed)	1.0
Heat strengthened	2.0
Fully tempered	4.0
Wired	0.5
Patterned[d]	1.0
Sandblasted[e]	0.5
Laminated, regular piles[a,b]	0.75
Laminated, heat strengthened plies[a, b]	1.5
Laminated, fully tempered plies[a,b]	3.0
Insulating Glass[c]	
Regular, (annealed)	1.8
Heat strengthened	3.6
Fully tempered	7.2
Laminated, regular piles[a,b]	1.4
Laminated, heat strengthened plies[a, b]	2.7
Laminated, fully tempered plies[a,b]	5.4

Note a. For laminated glass, use the line in Figure 2403.1 for total glass thickness (after adjusting wind load by the factor in Table 2403.1).

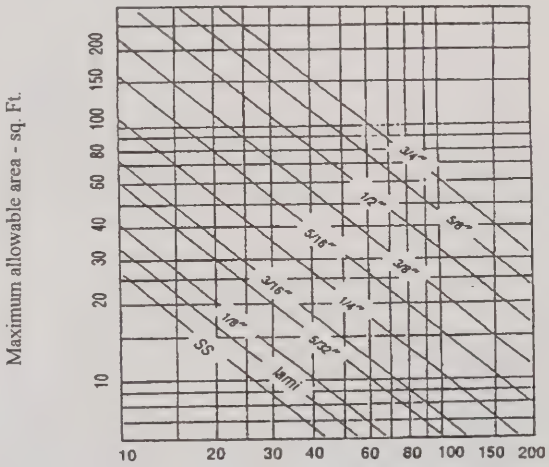
Note b. For laminated glass, values are based on two panes of identical thickness and type.

Note c. For insulated glass, values are based on two panes of identical thickness and type. Utilize thickness for one pane. For example, tha maximum allowable area for an insulating glass unit consisting of two plies of fully tempered ¼-inch glass is determined using the line for ¼-inch glass.

Note d. Values for patterned glass are based on the thinnest part of the pattern. Interpolation between lines in the figure is permitted.

Note e. Value for sandblasting glass is minimum and depends on severity and depth of sandblast.

Figure 2403.1
MAXIMUM ALLOWABLE AREA FOR VERTICAL AND SLOPED GLASS



Equivalent Load Determined from 780 CMR 2403.1 and Table 2403.0 or 780 CMR 2403.2 and 2403.2 on psf

Table 2403.2
FACTORS FOR SLOPED GLASS

Glass type	Factor for use with figure 2403.1
Single Glass	
Regualr (annealed)	0.72
Heat strengthened	1.7
fully tempered	3.6
Wired	0.36
Laminated, regular piles[a,b]	0.54
Laminated, heat strengthened plies[a, b]	1.3
Laminated, tempered plies[a,b]	2.7
Insulating Glass[c]	
Regular, (annealed)	1.3
Heat strengthened	3.1
Fully tempered	6.6
Laminated, regular piles[a,b]	1.0
Laminated, heat strengthened plies[a, b]	2.3
Laminated, fully tempered plies[a,b]	4.9

Note a. For laminated glass, use the line in Figure 2403.1 for total glass thickness (after adjusting wind load by the factor in Table 2403.2).

Note b. For laminated glass, values are based on two panes of identical thickness and type.

Note c. For insulated glass, values are based on two panes of identical thickness and type. Utilize thickness for one pane. For example, tha maximum allowable area for an insulating glass unit consisting of two plies of fully tempered ¼-inch glass is determined using the line for ¼-inch glass.

780 CMR 2404.0 SLOPED GLAZING AND SKYLIGHTS

2404.1 Sloped glazing: Any installation of glass or other transparent, translucent or opaque glazing material which is installed at a slope of 15 degrees (0.26 rad) or more from the vertical plane —including skylights, roofs and sloped walls—shall comply with 780 CMR2404.0.

2404.2 Allowable glazing materials: Sloped glazing shall be any of the following materials, subject to the limitations specified in 780 CMR 2404.3 and the exceptions specified in 780 CMR 2404.4:

1. For monolithic glazing systems, the glazing material of the single light or layer shall be laminated glass with a minimum 30-mil (762 μm) polyvinyl butyral interlayer, wired glass, approved *plastic* materials, heat-strengthened glass or fully tempered glass.
2. For multiple-layer glazing systems, each light or layer shall consist of any of the glazing materials specified in 780 CMR 2404.2 item 1.

For additional requirements for *plastic* skylights, see 780 CMR 2608.0. Glass-block construction shall conform to the requirements of 780 CMR 2115.0.

2404.3 Limitations: Where used in monolithic glazing systems, heat-strengthened glass and fully tempered glass shall have screens installed below the glazing material, subject to the exceptions in 780 CMR 2404.4, to protect building occupants from falling glass should breakage occur. The screens shall be capable of supporting the weight of the glass and shall be substantially supported below and installed within four inches (102 mm) of the glass. The screens shall be constructed of a noncombustible material not thinner than No. 12 B&S Gage (0.0808 inch) with a mesh not larger than one inch by one inch (25 mm by 25 mm). In a corrosive atmosphere, structurally equivalent noncorrosive atmosphere, structurally equivalent noncorrosive screening materials shall be used. Where used in multiple-layer glazing systems as the bottom glass layer over the walking surface, heat-strengthened glass, fully tempered glass and wired glass shall be equipped with screening that conforms to the requirements specified for monolithic glazing systems.

2404.4 Exceptions: In monolithic and multiple-layer sloped glazing systems, the following exceptions apply:

1. Fully tempered glass installed without protective screens where glazed between intervening floors at a slope of 30 degrees (0.52 rad) or less from the vertical plane shall have the highest point of the glass ten feet (3048 mm) or less above the walking surface.
2. Screens are not required below any glazing material, including annealed glass, where the walking surface below the glazing material is permanently protected from the risk of falling glass or the area below the glazing material is not a walking surface.
3. Any glazing material, including annealed glass, is permitted to be installed without screens in the sloped glazing systems of commercial or detached greenhouses used exclusively for growing plants and not open to the public, provided that the height of the greenhouse at the ridge does not exceed 20 feet (6096 mm) above grade. Greenhouse frames shall be noncombustible if the height of the sloped glazing exceeds 20 feet (6096 mm) above grade.
4. Screens shall not be required within dwelling units of occupancies in Use Groups R-2 and R-3 where fully tempered glass ***or laminated glass with a 15 mil polyvinyl butyral interlayer*** is used as single glazing or as both panes in an insulating glass unit, and all of the following conditions are met:
    4.1. Each pane of glass is 16 square feet (1.5 m^2) or less in area;
    4.2. The highest point of the glass is 12 feet (3658 mm) or less above any walking surface or other area having access thereto; and
    4.3. The glass thickness is 3/16 inch (5 mm) or less.

2404.5 Framing: In Types I and 2 construction, all sloped glazing and skylight frames shall be constructed of noncombustible materials. In buildings where acid fumes deleterious to metal are incidental to the occupancy of the buildings, approved pressure-treated woods or other approved noncorrosive materials shall be permitted for sash and frames. All sloped glazing and skylights shall be designed to meet all structural requirements for roofs specified in 780 CMR 16. All skylights set at an angle of less than 45 degrees (0.79 rad) from the horizontal plane shall be mounted at least four inches (102 mm) above the plane of the roof on a curb construction as required for the frame. Skylights shall not be installed in the plane of the roof where the roof pitch is less than 45 degrees (0.79 rad) from the horizontal.

Exception: Curbs for skylights are not required on roofs with a minimum slope of three units vertical in 12 units horizontal (3:12) in occupancies in Use Group R-3.

780 CMR 2405.0 SAFETY GLAZING

2405.1 Human impact loads: Individual glazed areas, including glass mirrors, in hazardous locations such as those indicated in 780 CMR 2405.2 shall pass the test requirements of CPSC 16 CFR; 1201 ***and shall conform to the requirements of M.G.L. c. 143, §§ 3T, 3U and 3V, as applicable***, listed in *Appendix A*. The requirements of 780 CMR 2405.1 and 780 CMR 2405.2 and 2407.0 shall apply equally to replacement glass and new glass installation. Additional requirements as specified in 780 CMR 2407.2 are to be satisfied for glass used in locations where the hazard is of a continuous nature, such as glass enclosures for sporting activities as identified in 780 CMR 2407.1.

Exceptions:

1. Polished wired glass used in required fire resistance rated assemblies ***or polished wire glass used in hazardous locations such as those indicated in 780 CMR 2405.2, items 6, 7, 8 and 9*** shall comply with ANSI Z97.1 listed in *Appendix A*.
2. Plastic glazing shall meet the weathering requirements of ANSI Z97.1 listed in *Appendix A*.
3. Glass-block walls shall comply with 780 CMR 2115.0.

2405.1.1 Marking: Each light of safety glazing material installed in hazardous locations as defined in 780 CMR 2405.2 shall bear a permanent identifying mark issued by an *approved agency* which specifies the marking agency, whether manufacturer or installer, and the test standard.

Exceptions

1. Polished wire glass is exempt from a permanent identifying mark provided that the distributor or the installer provides an affidavit certifying that the polished wire glass complies with ANSI Z97.1 listed in Appendix A.

2. Laminated glass is exempt from a permanent identifying mark provided that the distributor or installer provides an affidavit certifying that the laminated glass complies with CPSC 16 CFR 1201, listed in Appendix A.

2405.2 Specific hazardous locations: The following shall be considered specific hazardous locations for the purposes of glazing:

1. Glazing in ingress and *means of egress* doors except jalousies (see 780 CMR 2402.5).
2. Glazing in fixed and sliding panels of sliding (patio) door assemblies and panels in swinging doors.
3. Glazing in storm doors.
4. Glazing in all unframed swinging doors.
5. Glazing in doors and enclosures for hot tubs, whirlpools, saunas, steam rooms, bathtubs and showers. Glazing in any portion of a building wall enclosing these compartments where the bottom exposed edge of the glazing is less than 60 inches (1525 mm) above a standing surface.
6. Glazing in an individual fixed or operable panel adjacent to a door where the nearest exposed edge of the glazing is within a 24-inch (610 mm) arc of either vertical edge of the door in a closed position and where the bottom exposed edge of the glazing is less than 60 inches (1525 mm) above the walking surface.
7. Glazing in an individual fixed or operable panel, other than in those locations described in preceding items 5 and 6, which meets all of the following conditions:
   7.1. Exposed area of an individual pane greater than nine square feet (0.84 m2);
   7.2. Exposed bottom edge less than 18 inches (460 mm) above the floor:
   7.3. Exposed top edge greater than 36 inches (915 mm) above the floor; and
   7.4. One or more walking surface(s) within 36 inches (915 mm) horizontally of the plane of the glazing.
8. All glazing in guards and railings regardless of area or height above a walking surface. Included are structural baluster panels and nonstructural infill panels.
9. Glazing in walls and fences enclosing indoor and outdoor swimming pools where the bottom edge of the glazing on the pool side is less than 60 inches (1525 mm) above a walking surface and within 36 inches (914 mm) horizontally of a walking surface. This shall apply to single glazing and all panes in multiple glazing.

Exception: The following products, materials and uses shall not be considered specific hazardous locations:

1. Openings in doors through which a 3-inch (76 mm) sphere is unable to pass.
2. Assemblies of leaded glass or faceted glass and items of carved glass used for decorative purposes in locations described in 780 CMR 2405.2, items 1, 6 or 7.
3. Glazing materials used as curved glazed panels in revolving doors.
4. Commercial refrigerated cabinet glazed doors.
5. Glazing as described in 780 CMR 2405.2, item 6, where there is an intervening wall or some other permanent barrier that will prevent a person approaching the door from accidentally striking the glazing.
6. Glazing as described in 780 CMR 2405.2, item 7, where a protective bar is installed 34 inches to 38 inches (864 mm to 965 mm) above the floor on the side of the glazing having access thereto. The bar shall be capable of withstanding a horizontal load of 50 pounds per linear foot (730 N/m) without contacting the glass and be a minimum of 1½ inches (38 mm) in height. ***The protective bar may be an applied bar or an integral part of the glazed framing dividing an upper lite from a lower lite.***
7. Outboard panes in insulating glass units and other multiple-glazed panels as described in 780 CMR 2405.2, item 7, where the bottom exposed edge of the glass is 25 feet (7620 mm) or more above any grade, roof, walking surface

or other horizontal or sloped (within 45 degrees of horizontal) surface adjacent to the glass exterior.

8. Louvered windows and jalousies complying with the requirements of 780 CMR 2402.5.
9. Glazing which is mounted or hung on a surface that provides a continuous backing support.

2405.3 Glass in fire-fighter access panels: In cases where tempered glass is required in fire-fighter access panels, both panes in double glazing shall be tempered glass.

780 CMR 2406.0 GLASS IN HANDRAILS AND GUARDRAILS

2406.1 Materials: Glass used as structural balustrade panels in railings shall be constructed of either single fully tempered glass, laminated fully tempered glass or laminated heat-strengthened glass. Glazing in railing in-fill panels shall conform to ANSI Z97.1 listed in ***Appendix A*** or shall be of an approved safety glazing material that conforms to the provisions of 780 CMR 2405.1. For all glazing types, the minimum nominal thickness shall be ¼ inch. Fully tempered glass and laminated glass shall comply with Category II of CPSC 16 CFR; 1201, listed in ***Appendix A***. Wired glass shall comply with ANSI Z97.1 listed in ***Appendix A.***

2406.1.1 Loads: The panels and their support system shall be designed to withstand the *loads* specified in 780 CMR 1606.4. A safety factor of 4 shall be used.

2406.1.2 Support: Each handrail or guardrail section shall be supported by a minimum of three glass balusters or shall be otherwise supported to remain in place should one baluster panel fail. Glass balusters shall not be installed without an attached handrail or guardrail.

2406.1.3 Parking garages: Glazing materials shall not be installed in railings in parking *garages* except for pedestrian areas not exposed to impact from vehicles.

780 CMR 2407.0 GLAZING IN RACQUETBALL AND SQUASH COURTS

2407.1 Continuously hazardous locations: The following shall be considered continuously hazardous locations for the purposes of glazing:

1. Glazing in squash and racquetball courts which forms whole or partial wall sections.
2. Glazing in squash and racquetball courts which is used as a door or part of a door.

2407.2 Testing: Test methods and loads for individually glazed areas such as those described in 780 CMR 2407.1 shall conform to those of CPSC 16 CFR; 1201, listed in ***Appendix A***, with impacts being applied at a height from ground level of 59 inches (1499 mm) to an actual or simulated glass wall installation with fixtures, fittings and methods of assembly identical to those used in practice.

In order to be deemed acceptable, the following conditions shall be achieved for glass walls:

1. Any glass wall in a squash or racquetball court shall remain intact following a test impact.
2. The deflection of such walls shall not be greater than 1½ inches (38 mm) at the point of impact.

In order to be deemed acceptable, the following conditions shall be achieved for glass doors:

1. Glass doors shall remain intact following a test impact at the prescribed height in the center of the door.
2. The relative deflection between the edge of a glass door and the adjacent wall shall not exceed the following values for the impact test bag-drop heights:
    - 2.1. The thickness of the wall plus ⅛ inch (3 mm) for a drop height of 24 inches (610 mm).
    - 2.2. The thickness of the wall plus ¼ inch (6 mm) for a drop height of 36 inches (914 mm).
    - 2.3. The thickness of the wall plus ½ inch (13 mm) for a drop height of 48 inches (1219 mm).

NON-TEXT PAGE

CHAPTER 25

GYPSUM BOARD AND PLASTER

780 CMR 2501.0 GENERAL

2501.1 Scope: The provisions of 780 CMR 25 shall govern the materials, design, construction and quality of gypsum and plaster.

780 CMR 2502.0 SHEAR WALLS

2502.1 General: Wood frame shear walls constructed in accordance with the materials and provisions of Table 2502.1 are permitted to resist wind and seismic forces. Where such construction is designed to resist seismic forces, the panel size and arrangement provisions of 780 CMR 2306.4.7 shall be met in addition to 780 CMR 2502.0.

2502.1.1 Nailing: All studs, top and bottom plates and blocking shall be nailed in accordance with Table 2502.1.

2502.1.2 Limitations: Shear walls shall not be used to resist horizontal *loads* from masonry or concrete walls.

Table 2502.1
SHEAR CAPACITY FOR SHEAR WALLS OF LATH AND PLASTER, GYPSUM SHEATHING BOARD, AND GYPSUM WALLBOARD WOOD FRAME ASSEMBLIES[b]

Type of material		Thickness of material (inch)	Wall construction	Nail spacing maximum (inches)	Allowable shear pounds per foot of wall[a]	Fastener size
Woven or welded wire lath and portland cement plaster		⅞	Unblocked	6	180	No. 11 gage, 1½ inches ling, 7/16-inch head, or No. 16 gage staples having ⅞-inch-long legs
Gypsum lath, plain or perforated		⅜ lath and ½ plaster	Unblocked	5	100	No. 13 gage, 1⅛ inches long, 19/64- inch head, plasterboard blued nail
Gypsum sheathing board	2 feet x 8 feet	½	Unblocked	4	75	No 11 gage, 1¾ inches long, 7/16-inch head, diamond point, galvanized
	4 feet x 8 feet		Blocked	4	175	
	4 feet x 8 feet		Unblocked	7	100	
Gypsum wallboard		½	Unblocked	7	100	5d cooler nails
			Unblocked	4	125	
			Blocked	7	125	
			Blocked	4	150	
		⅝	Blocked	4	175	6d cooler nails
			Blocked two ply	Base ply 9 inches Face ply 7 inches	250	Base ply - 6d cooler nails Face ply - 8d cooler nails

Note a. Shear values are based on a maximum framing spacing of 16 inches (406 mm) on center.
Note b. 1 inch = 25.4 mm; 1 foot = 304.8 mm; 1 pound per foot = 1,489 kg/m.

780 CMR 2503.0 GYPSUM BOARD MATERIALS

2503.1 General: All gypsum board materials and accessories shall be marked to indicate the appropriate standards referenced in 780 CMR 2503 and stored so as to protect such materials from the weather.

2503.2 Standards: All gypsum board materials shall conform to the appropriate standards listed in Table 2503.2 and ***Appendix A***.

Table 2503.2
GYPSUM BOARD MATERIALS AND ACCESSORIES

Material	Standard
Gypsum sheathing	ASTM C79
Gypsum wallboard	ASTM C36
Joint reinforcing tape and compound	ASTM C474; C475
Nails for gypsum boards	ASTM C514
Steel screws	ASTM C1002; C954
Steel studs, nonloadbearing	ASTM C645
Water-resistant gypsum backing board	ASTM C630

2503.3 Installation: Installation of these materials shall conform to 780 CMR 2504.0 and Table 2503.3, except as otherwise required by 780 CMR.

2503.4 Water-resistant gypsum backer board: In all areas subjected to repeated damp conditions and moisture accumulation such as bathtub and shower compartments, water-resistant gypsum backer board complying with ASTM C630 listed in ***Appendix A*** shall be used as a substratum unless protected with a moistureproof and vaporproof covering.

Table 2503.3
MAXIMUM SPACING OF GYPSUM WALLBOARD FASTNERS

Thickness of gypsum wallboard (inch)	Plane of framing surface	Long dimension of gypsum wallboard sheets in relation to direction of framing members	Maximum spacing of framing members (center-to-center in inches)	Maximum spacing of fasteners (center-to-center in inches)		Nails[a] to wood
				Nails[a,b]	Screws[c]	
½	Horizontal	Either direction	16	7	12	No 13 gage, 1⅜" long 19/64" head, /0.098 inch diameter, 1¼ long, Annular ringed, 5d cooler nail
	Horizontal	Perpendicular	24	7	12	
	Vertical	Either direction	24	8	12	
⅝	Horizontal	Either direction	16	7	12	No. 13 gage, 1⅝" long, 19/64" head, 0.098 inch diameter, 1⅜" long, Annular ringed, 6d cooler nail.
	Horizontal	Perpendicular	24	7	12	
	Vertical	Either direction	24	8	12	
Fastening required with adhesive application						
½ or ⅝	Horizontal	Either direction	16	16	16	As required for ½" and ⅝" gypsum wallboard, see above
	Horizontal	Perpendicular	24	12	16	
	Vertical	Either direction	24	16	24	
2 layers each ⅜" (¾ total)	Horizontal	Perpendicular	24	16	16	Base ply nailed as required for ½" gypsum wallboard and face ply placed with adhesive
	Vertical	Either direction	24	24	24	

Note a. Where the metal framing has a clinching design formed to receive the nails by two edges of metal, the nails shall not be less than ⅝ inch longer than the wallboard thickness, and shall have ringed shanks. Where the metal framing has a nailing groove formed to receive the nails, the nails shall have barbed shanks or be 5d cooler nails (No 13½ gage, 1⅝ inches long, 15/64-inch head) for ½-inch gypsum wallboard (No. 13 gage, 1⅞ inches long, 15/64-inch head) for ⅝-inch gypsum wallboard.

Note b. Two nails at two inches to 2½ inches apart are permitted to be used if the pairs are spaced 12 inches center-to-center except around perimeters.

Note c. Screws shall be No. 6 with tapered head and long enough to penetrate into wood framing not less than ⅝ inch and metal framing not less than ¼ inch.

Note d. For fireresistance rated construction assemblies, see the pertinent fire test information.

Note e. 1 inch = 25.4 mm.

780 CMR 2504.0 GYPSUM CONSTRUCTION

2504.1 General: Gypsum board and plaster construction shall be of the materials listed in Table 2503.2 and Table 2505.2. These materials shall be assembled and installed in compliance with the appropriate standards listed in Table 2504.l and *Appendix A.*

Table 2504.1
INSTALLATION OF GYPSUM CONSTRUCTION

Material	Standard
Gypsum plaster	ASTM C842
Gypsum veneer base	ASTM C844
Gypsum veneer plaster	ASTM C843
Interior lathing and furring	ASTM C841
Steel framing for gypsum boards	ASTM C754; C1007

2504.2 Limitations: Gypsum construction shall not be used in any exterior location where such gypsum construction will be exposed directly to the weather.

2504.3 Inspection: The building official shall be notified not less than 24 hours in advance of all plastering work or installation of any gypsum board except gypsum lath. Plaster shall not be applied until after the lathing or other plaster base has been inspected and approved.

2504.4 Weather protection: When plastering work is in progress, the building or structure shall be enclosed and conditioned to provide proper *ventilation* and temperatures not less than 40°F (4°C) nor more than 80°F (27°C) from one week prior to the plastering operation and until one week following or until the plaster is dry.

780 CMR 2505.0 INTERIOR LATHING AND GYPSUM PLASTERING

2505.1 General: All interior lathing and gypsum plastering materials and accessories shall be marked to indicate the appropriate standards referenced in 780 CMR 2505.0 and stored in such a manner as to protect them from the weather.

2505.2 Standards: All interior lathing and gypsum plastering materials shall conform to the standards listed in Table 2505.2 and *Appendix A* and, where required for fire protection, shall also conform to the provisions of 780 CMR 7.

Table 2505.2
PLASTERING MATERIALS AND ACCESSORIES

Material	Standard
Exterior plaster bonding compounds	ASTM C932
Gypsum base for veneer plasters	ASTM C588
Gypsum casting and molding plaster	ASTM C59
Gypsum Keene's cement	ASTM C61
Gypsum lath	ASTM C37
Gypsum plaster	ASTM C28
Gypsum veneer plaster	ASTM C587
Interior bonding compounds, gypsum	ASTM C631
Lime plasters	ASTM C5; C206
Metal lath	ASTM C847
Plaster aggregates	
Sand	ASTM C35; C897
Perlite	ASTM C35
Vermiculite	ASTM C35
Portland cement	ASTM C150
Steel studs and track	ASTM C645; C955
Steel screws	ASTM C1002; C954
Welded wire lath	ASTM C933

2505.3 Installation: Installation of interior lathing and gypsum plastering materials shall conform to 780 CMR 2504.0.

780 CMR 2506.0 PORTLAND CEMENT STUCCO LATHING AND PLASTERING

2506.1 General: All exterior and interior portland cement stucco lathing and plastering shall be done with the appropriate materials listed in Table 2505.2 and *Appendix A.*

2506.2 Weather protection: All materials shall be stored in such a manner as to protect such materials from the weather.

2506.3 Installation: Installation of these materials shall be in compliance with ASTM C926 and ASTM C 1063 listed in and 780 CMR 2506.4.

2506.4 Protection after application: At all times during application and for a period of not less than 48 hours after application of each coat, provisions shall be made to keep stucco work above 40°F (4°C).

NON-TEXT PAGE

CHAPTER 26

PLASTIC

780 CMR 2601.0 GENERAL

2601.1 Scope: The provisions of 780 CMR 26 shall govern the design, construction and quality of light-transmitting *plastic* materials and foam plastics. 780 CMR 2601.0 shall apply to all light-transmitting *plastic* materials and foam plastics. 780 CMR 2603.0 shall only apply to foam plastics. 780 CMR 2604.0 through 2608.0 shall only apply to light-transmitting *plastic* materials.

2601.2 Approved materials: The use of all *plastics* that conform to the strength, durability, sanitary and fireresistive requirements of this code and ASTM D635, D1929, D2843 and E84 listed in ***Appendix A,*** shall be permitted subject to the limitations of 780 CMR 26.

2601.3 Application for approval: Applicants for approval of a *plastic* material shall furnish, in accordance with 780 CMR 1704.0 all necessary technical data required by the code official. The data shall include, if necessary: chemical composition; applicable physical, mechanical and thermal properties, such as fireresistance, flammability and flame spread; weather resistance; electrical properties; products of combustion; and coefficients of expansion.

2601.4 Identification: All *plastic* materials approved for use under 780 CMR shall be identified by the trade formula number or name or other acceptable identification. Each unit or package shall bear the approval number or other identification mark of the approving authority.

2601.5 Interior finish and trim: Light-transmitting *plastic* materials installed as interior finish or trim shall comply with 780 CMR 803.0. Foam plastics shall only be installed as interior finish in accordance with 780 CMR 2603.8. Foam plastics installed as interior trim shall comply with 780 CMR 2603.7.

780 CMR 2602.0 DEFINITIONS

2602.1 General: The following words and terms shall, for the purposes of 780 CMR 26 and as used elsewhere in 780 CMR, have the meanings shown herein.

Plastic

Light-diffusing system: A suspended construction consisting in whole or in part of lenses, panels, grids or baffles suspended below independently mounted electrical lighting sources.

Plastic glazing: *Plastic* materials which are glazed or set in frame or sash and not held by mechanical fasteners which pass through the glazing material.

Plastic roof panels: *Plastic* materials which are fastened to structural members, or to structural panels or sheathing, and which are used as light-transmitting media in roofs.

Plastic wall panels: *Plastic* materials which are fastened to structural members, or to structural panels or sheathing, and which are used as light-transmitting media in exterior walls.

Reinforced plastic, glass fiber: *Plastic* reinforced with glass fiber having not less than 20% of glass fibers by weight.

Thermoplastic material: A *plastic* material which is capable of being repeatedly softened by increase of temperature and hardened by decrease of temperature.

Thermosetting material: A *plastic* material which is capable of being changed into a substantially nonreformable product when cured.

780 CMR 2603.0 FOAM PLASTIC

2603.1 General: The provisions of 780 CMR 2603.0 shall govern the requirements and uses of foam plastic in buildings or structures.

2603.1.1 Urea based foamed-in-place insulation: Use of this material has been banned by the Massachusetts Department of Public Health.

2603.2 Labeling: Foam plastics or their packages of foam plastics, and containers of foam-in-place plastic system ingredients, shall be *labeled* in compliance with 780 CMR 1704.3.

2603.3 Surface-burning characteristics: Unless otherwise indicated in 780 CMR 2603.0, all foam plastic and foam plastic cores of manufactured assemblies shall have a flame spread rating of not more than 75 and a smoke-developed rating of not more than 450 when tested in the maximum thickness intended for use in accordance with ASTM E84 listed in ***Appendix A.***

Exceptions:

1. Smoke-developed ratings for interior trim as provided for in 780 CMR 2603.7.4.
2. Flame spread ratings for exterior wall installations as provided for in 780 CMR 2603.6.3 and 2603.6.8.
3. Flame spread and smoke-developed ratings for roof applications as provided for in 780 CMR 2603.4.1.5.
4. Where foam plastic is tested in a thickness of four inches (102 mm) and is used in a thickness of

greater than four inches (102 mm) up to ten inches (254 mm), the building shall be equipped throughout with an *automatic sprinkler system* in accordance with 780 CMR 906.2.1 and the foam plastic shall be protected by a thermal barrier.

2603.4 Thermal barrier: Except as provided for in 780 CMR 603.4.1, all foam plastic shall be separated from the interior of a building by an approved thermal barrier of ½-inch gypsum wallboard or equivalent thermal barrier material which will limit the average temperature rise of the unexposed surface to not more than 250°F (121°C) after 15 minutes of fire exposure, complying with the standard time-temperature curve of ASTM E119 listed in ***Appendix A***. The thermal barrier shall be installed such that said thermal barrier will stay in place for a minimum of 15 minutes under the same test conditions.

2603.4.1 Thermal barrier not required: The thermal barrier specified in 780 CMR 2603.4 is not required under the conditions set forth in any one of 780 CMR 2603.4.1.1 through 2603.4.1.8.

2603.4.1.1 Siding backer board: Foam plastic to be used as siding backer board, or where applied as insulation with re-siding over existing exterior wall construction, shall have a maximum thickness of ½ inch (13 mm) and shall be separated from the interior of the building by not less than two inches (51 mm) of mineral fiber insulation or other approved materials.

2603.4.1.2 Walk-in coolers: Where foam plastic is used in a maximum thickness of four inches (102 mm) in walk-in coolers or in freezer units less than 400 square feet (37.2 m^2) in floor area, the foam plastic shall be covered by a metal facing of not less than 0.032-inch-thick aluminum or corrosion-resistant steel having a minimum base metal thickness of 0.016 inch.

2603.4.1.3 Masonry or concrete construction: Where the foam plastic is protected by a one-inch (25 mm) minimum thickness of masonry or concrete, a thermal barrier is not required.

2603.4.1.4 Attics and crawl spaces: Within an *attic* or crawl space where entry is made only for service of utilities, foam plastic shall be protected against ignition by 1½ inch-thick (38 mm) mineral fiber insulation, ¼-inch-thick wood structural panel, *particleboard* or hardboard, ⅜-inch gypsum wallboard, corrosion-resistant steel having a base metal thickness of 0.016 inch, or other approved material installed in such a manner that the foam plastic is not exposed. The protective covering shall be consistent with the requirements for the type of construction.

2603.4.1.5 Roofing: Foam plastic used in a roof covering assembly that employs a wood roof deck without the thermal barrier shall have the foam plastic separated from the interior of the building by wood structural panel sheathing or tongue-and-groove wood plank sheathing not less than 15/32 inch in thickness or other approved materials. All wood structural panel roof sheathing shall be bonded with exterior glue with edges supported by blocking, tongue-and-groove joints or other approved type of edge support.

The requirements of 780 CMR 2603.3 and 2603.4 are not applicable to foam plastic roof insulation used in roof deck construction that complies as an assembly with FM 4450 or UL 1256 listed in ***Appendix A***.

For all roof applications, the smoke-developed rating shall not be applicable.

2603.4.1.6 Doors not required to have a fireresistance rating: Where doors are permitted without a fireresistance rating and foam plastic is used as a core material, the door facing shall be of metal having a minimum thickness of 0.032-inch aluminum or 0.016-inch steel.

2603.4.1.7 Exterior doors in buildings of Use Group R-3: In buildings of Use Group R-3, foam-filled exterior entrance doors that do not require a fireresistance rating shall be faced with wood or other approved materials.

2603.4.1.8 Exterior walls, one-story buildings: A thermal barrier is not required in the exterior wall application provided for in 780 CMR 2603.6.8.

2603.5 Exterior applications: Foam plastic installed in or on the exterior side of walls of buildings shall also comply with the applicable requirements of 780 CMR 1405.0.

2603.6 Exterior walls: Foam plastic installed in or on the exterior side of exterior walls in buildings of Type 1, 2, 3 or 4 construction shall comply with the requirements of 780 CMR 2603.6.1 through 2603.6.7 or, in one-story buildings, shall comply with the requirements of 780 CMR 2603.6.8.

2603.6.1 Fireresistance rating: Foam plastic is permitted within exterior walls provided that the wall assembly affords the required fireresistance rating.

2603.6.2 Thickness: The foam plastic shall be limited to a maximum thickness of four inches (102 mm).

2603.6.3 Flame spread: The foam plastic core, coatings and facings, when tested individually, shall each have a flame spread rating of 25 or less when tested in accordance with ASTM E84 listed in *Appendix A*.

2603.6.4 Fastening: Facing, coating and core materials shall be fastened to each other, and the overall assembly shall be fastened to the building frame to prohibit failure in bond due to temperatures that occur in a building fire, *wind loads* or other conditions.

2603.6.5 Full-scale tests: Results of full-scale fire tests, which reflect an end-use configuration and which demonstrate that the assembly in its final form does not show any tendency to propagate flame over the surface or through the core when exposed on the exterior face to a fire source, shall be submitted to the code official. Such testing shall be performed on the finished manufactured foam plastic assemblies and on the maximum thickness intended for installation.

2603.6.6 Thermal barrier: Any foam plastic shall be separated from the building interior by a thermal barrier unless specific approval is obtained on the basis of 780 CMR 2603.8.

2603.6.7 Identification: The edge or face of each piece of foam plastic insulation shall be *labeled* in accordance with 780 CMR 1704.3.

2603.6.8 Exterior walls, one-story buildings: Foam plastic insulation having a flame spread rating of not more than 25 and installed without a thermal barrier in or on exterior walls of one-story buildings, shall have a thickness of not more than four inches (102 mm). The foam plastic shall be covered by a thickness of not less than 0.032-inch aluminum or corrosion- resistant steel having a base metal thickness of 0.016 inch and the *building area* shall be equipped throughout with an *automatic sprinkler system* in accordance with 780 CMR 906.2.1.

2603.7 Interior trim: Foam plastic used as interior trim shall comply with 780 CMR 2603.7.1 through 2603.7.4.

2603.7.1 Density: The minimum density of the interior trim shall be 20 pounds per cubic foot (320 kg/m^3).

2603.7.2 Thickness: The maximum thickness of the interior trim shall be ½ inch (13 mm) and the maximum width shall be four inches (102 mm).

2603.7.3 Area limitation: The interior trim shall not constitute more than 10% of the aggregate wall and ceiling area of any room or space.

2603.7.4 Flame spread: The flame spread rating shall not exceed 75 when tested in accordance with ASTM E84 listed in *Appendix A*. The smoke-developed rating shall not be limited.

2603.8 Alternative approval: Foam plastic is not required to comply with the requirements of 780 CMR 2603.4 through 2603.7 when specifically approved based on tests such as FM Procedure 4880, UL Subject 1040 or UL 1715 listed in *Appendix A*. Such testing shall be performed on the finished manufactured foam plastic assemblies and on the maximum thickness intended for use. Foam plastics which are used as interior finish on the basis of diversified tests shall also conform to the flame spread requirements of 780 CMR 803.0. All assemblies tested shall include seams, joints and other typical details used in the installation of the assembly and shall be tested in the manner intended for use.

780 CMR 2604.0 GENERAL REQUIREMENTS FOR LIGHT-TRANSMITTING PLASTICS

2604.1 Approved light-transmitting plastics: An approved light-transmitting *plastic* shall be: any thermoplastic, thermosetting or reinforced thermosetting *plastic* material which has a self-ignition temperature of 650°F (343°C) or greater when tested in accordance with ASTM D1929 listed in *Appendix A*; a smoke density rating not greater than 450 when tested in the manner intended for use in accordance with ASTM E84 listed in *Appendix A*, or not greater than 75 when tested in the thickness intended for use in accordance with ASTM D2843 listed in *Appendix A*; and which conforms to one of the following combustibility classifications:

Class C1: *Plastic* materials which have a burning extent of one inch (25 mm) or less when tested at a nominal thickness of .060 inch, or in the thickness intended for use, in accordance with ASTM D635 listed in *Appendix A*, or

Class C2: *Plastic* materials which have a burning rate of 2.5 inches per minute (1.06 mm/s) or less when tested at a nominal thickness of .060 inch, or in the thickness intended for use, in accordance with ASTM D635 listed in *Appendix A*.

2604.2 Structural requirements: All *plastic* materials and associated assemblies shall be of adequate strength and durability to withstand the *loads* and forces specified in 780 CMR 16 for the approved application.

2604.3 Connections and supports: All fastenings, connections and supports shall be proportioned to transmit safely two and one-half times the design *live load*. Adequate allowance shall be made in the fastenings and supports for differential expansion and contraction of the connected materials.

2604.4 Other applicable requirements: Light-transmitting *plastics* installed as exterior wall panels shall conform to 780 CMR 2605.0. Light-transmitting *plastics* installed in glazing of unprotected openings shall conform to 780 CMR 2606.0. Light-transmitting *plastics* installed as roof panels shall conform to 780 CMR 2607.0. Light-transmitting *plastics* installed in skylight assemblies shall conform to 780 CMR 2608.0.

2604.5 Light-diffusing systems: Light-diffusing systems shall not be installed in occupancies in Use Group I-2 or I-3, nor in exits, unless the building is equipped throughout with an *automatic sprinkler system* in accordance with 780 CMR 906.2.1. *Plastic* diffusers shall be supported directly or indirectly from ceiling or roof construction by use of noncombustible hangers. Hangers shall be at least No. 12 steel-wire gage (0.106 inch) galvanized wire or equivalent.

2604.5.1 Installation: Approved light-transmitting *plastic* diffusers shall comply with 780 CMR 803.0 unless the *plastic* panels will fall from the mountings before igniting and at an ambient temperature of at least 200°F (93°C) below the ignition temperature of the panels. The panels shall remain in place at an ambient room temperature of 175°F (79°C) for a period of not less than 15 minutes

2604.5.2 Size limitations: Individual panels or units shall not exceed ten feet (3048 mm) in length nor 30 square feet (2.79 m^2) in area.

2604.5.3 Fire suppression system: In buildings that are equipped throughout with an *automatic sprinkler system* in accordance with 780 CMR 906.2.1, *plastic* light-diffusing systems shall be protected both above and below unless the *sprinkler* system has been specifically approved for installation only above the light-diffusing system. Areas of light-diffusing systems that are protected in accordance with 780 CMR 2604.0 shall not be limited.

2604.5.4 Electrical lighting fixtures: *Plastic* light-transmitting panels and light diffuser panels which are installed in approved electrical lighting fixtures shall comply with the requirements of 780 CMR 803.0 unless the *plastic* panels conform to the requirements of 780 CMR 2604.5.1. The area of approved *plastic* materials that are used in required *exits* or *corridors* shall not exceed 30% of the aggregate area of the ceiling in which such panels are installed, unless the building is equipped throughout with an *automatic sprinkler system* in accordance with 780 CMR 906.2.1.

2604.6 Partitions: Approved light-transmitting *plastics* used in or as partitions shall comply with the requirements of 780 CMR 603.2 and 803.0.

2604.7 Bathroom accessories: Approved *plastics* shall be permitted as glazing in shower stalls, shower doors, bathtub enclosures and similar accessory units (see 780 CMR 2405.0).

2604.8 Awnings and similar structures: Approved light-transmitting *plastics* used on awnings and similar structures shall comply with the general performance provisions of 780 CMR.

780 CMR 2605.0 LIGHT-TRANSMITTING WALL PANELS

2605.1 General: Approved light-transmitting *plastic* materials shall not be used as wall panels in exterior walls in occupancies in Use Groups A-1, A-2, I-2 and I-3. In all other use groups approved light-transmitting *plastic* materials shall be permitted to be used as wall panels in exterior walls provided that the walls are not required to have a fireresistance rating and the installation conforms to the requirements of 780 CMR 2605.0. Such panels shall be erected and anchored on a foundation coat, waterproofed or otherwise protected from moisture absorption and sealed with a coat of mastic or other approved waterproof coating. Refer to 780 CMR 2604.0 for requirements for approved light-transmitting *plastics*.

2605.2 Installation: Exterior wall panels installed as provided for herein shall not alter the type of construction classification of the building.

2605.3 Height limitation: Light-transmitting plastics shall not be installed more than ***70 feet (21336mm)*** above mean grade, except as allowed by 780 CMR 2605.7.

2605.4 Area limitation and separation: The maximum area of a single wall panel and minimum vertical and horizontal separation requirements for exterior *plastic* wall panels shall be as provided for in Table 2605.4. The maximum percentage of wall area of any story in *plastic* wall panels shall not exceed that indicated in Table 2605.4 or the percentage of unprotected openings permitted by 780 CMR 705.3, whichever is smaller.

Exception: Veneers of approved weather-resistant plastics used as exterior siding in buildings of Type 5 construction in compliance with 780 CMR 1405.2.

2605.5 Spandrel separation: Vertical spandrel wall separation shall be in accordance with Table 2605.4. See 780 CMR 2604.1 for the definition of C1 and C2 light-transmitting *plastics*.

2605.6 Fire canopies: In structures which are provided on any floor above the first with continuous architectural projections constituting an effective fire canopy extending at least 36 inches (914 mm) from the surface of the wall in which *plastic* wall panels are installed, vertical separation at that floor is not required except as provided by the vertical thickness of the projection.

2605.7 Automatic sprinkler system: Where the building is equipped throughout with an *automatic sprinkler system* in accordance with 780 CMR

906.2.1, the maximum percentage area of exterior wall in any story in *plastic* wall panels and the maximum square footage of a single area given in Table 2605.4 shall be increased 100%, but the area of *plastic* wall panels shall not exceed 50% of the wall area in any story, or the area permitted by 780 CMR 705.3.1 for unprotected openings, whichever is smaller. These installations shall be exempt from height limitations.

Table 2605.4
AREA LIMITATION AND SEPARATION REQUIREMENTS FOR LIGHT-TRANSMITTING PLASTIC WALL PANELS[a]

Fire separation distance (feet)[d]	Class of plastic	Maximum percentage area of exterior wall in plastic panels	Maximum single area (square feet)[d]	Minimum separation of panels (feet)[d]	
				Vertical	Horizontal
< 6	-	NP[c]	NP	-	-
6 or more but less than 11	C1	10	50	8	4
	C2	NP	NP	-	-
11 or more but less than 30	C1	25	90	6	4
	C2	15	70	8	4
> 30	C1	50	Not limited	3[b]	0
	C2	50	100	6[b]	3

Note a. For combination of glazing and wall panel areas permitted, see 780 CMR 2605.8.

Note b. For reductions in vertical separation allowed, see 780 CMR 2605.0.

Note c. NP = Not permitted.

Note d. 1 foot = 304.8 mm; 1 square foot = 0.093 m^2.

2605.8 Combinations of glazing and plastic wall panels: Combinations of *plastic* glazing and *plastic* wall panels shall be subject to the area, height and percentage limitations and the separation requirements applicable to the class of *plastic* asprescribed for plastic wall panel installations.

780 CMR 2606.0 LIGHT-TRANSMITTING PLASTIC GLAZING OF UNPROTECTED OPENINGS

2606.1 Where permitted: *Plastic* glazing is permitted in doors, sashes and framed openings where *protected* openings are not required in accordance with 780 CMR 705.0 and the installation conforms to the requirements of 780 CMR 2606.2 or 780 CMR 2606.3.

2606.2 Approved plastic glazing: Approved *plastic* glazing shall comply with 780 CMR 2606.2.1 through 2606.2.3.

2606.2.1 Area: The area of the glazing shall not exceed 25% of the wall face of the story in which such glazing is installed or the area of unprotected openings permitted by 780 CMR 705.3, whichever is smaller.

Exception: Where the building is equipped throughout with an *automatic sprinkler system* in accordance with 780 CMR 906.2.1, the area of the glazing shall not exceed 50% of the wall face of the story in which such glazing is located or the area of unprotected openings permitted by 780 CMR 705.3.1, whichever is smaller.

2606.2.2 Size: The area of a unit or pane of glazing installed above the first story shall not exceed 16 square feet (1.49 m^2) and the vertical dimension of a unit or pane shall not exceed four feet (1219 mm). There shall be a minimum three-foot (914 mm) vertical spandrel wall between stories.

2606.2.3 Height: Approved *plastic* glazing shall not be installed more than ***70 feet (21336 mm)*** above mean grade.

2606.3 Approved thermoplastic glazing: Approved thermoplastic materials installed in areas up to 50% of the wall area of each story, but not exceeding the area of unprotected openings permitted by 780 CMR 705.3, are permitted in structures less than 150 feet (45720 mm) in *height* provided that each floor above the first floor is equipped with continuous architectural projections constituting an effective fire canopy extending at least three feet (914 mm) from the surface of the wall in which the glazing is installed. The size and the dimensions of individual units shall not be limited in such installations except as required to meet structural *loading* requirements.

780 CMR 2607.0 LIGHT-TRANSMITTING PLASTIC ROOF PANELS

2607.1 General: Approved light-transmitting *plastic* roof panels shall not be installed in occupancies in Use Groups H, I-2 and I-3. In all other use groups, approved light-transmitting *plastic* roof panels shall not be installed unless one of the following conditions applies:

1. The building is equipped throughout with an *automatic sprinkler system* in accordance with 780 CMR 906.2.1;
2. The roof construction is not required to have a fireresistance rating by Table 602; or
3. The roof panels meet the requirements for roof coverings.

2607.2 Separations: Individual roof panels shall be separated from each other by a distance of not less than four feet (1219 mm) measured in a horizontal plane, except that the separation between roof panels is not required in a building equipped throughout with an *automatic sprinkler system* in accordance with 780 CMR 906.2.1.

2607.3 Location: Where exterior wall openings are required to be *protected* by 780 CMR 705.0, a roof panel or unit shall not be installed within six feet (1829 mm) of such exterior wall.

2607.4 Area limitations: Roof panels or units shall be limited in area and the aggregate area of panels shall be limited by a percentage of the floor area of the room or space sheltered in accordance with Table 2607.4.

Exceptions:

1. The area limitations of Table 2607.4 shall be increased by 100% in buildings equipped throughout with an *automatic sprinkler system* in accordance with 780 CMR 906.2.1.
2. Low-hazard occupancy buildings, such as swimming pool shelters and greenhouses, are exempt from the area limitations of Table 2607.4 provided that the buildings do not exceed 5,000 square feet (465 m^2) in *area* and have a minimum *fire separation distance* of four feet (1219 mm).
3. Roof coverings over terraces and patios in occupancies in Use Group R-3 are exempt from the area limitations of Table 2607.4 and shall be permitted with approved *plastics*.

Table 2607.4
AREA LIMITATIONS FOR ROOF PANELS

Class of plastic	Maximum area individual unit or panel (square feet)[a]	Maximum aggregate area (% of floor area)
C1	300	30
C2	100	25

Note a. 1 square foot = 0.093 m^3

780 CMR 2608.0 LIGHT-TRANSMITTING SKYLIGHT GLAZING

2608.1 Light-transmitting plastic glazing of skylight assemblies: Skylight assemblies glazed with approved light-transmitting *plastic* materials shall conform to the provisions of 780 CMR 2608.0.

Exceptions:

1. 780 CMR 2608.1 shall not apply to a skylight of approved light-transmitting *plastic* on a building which is not more than one story in *height*, has a *fire separation distance* of at least 30 feet (9144 mm) and the room or space sheltered by the roof is not classified as Use Group I-2 or I-3 or as a *means of egress*.
2. 780 CMR 26.08.1 shall not apply to skylights in which the approved light-transmitting *plastic* conforms to the required roof covering class in accordance with 780 CMR 1506.0.

2608.2 Mounting: The *plastic* shall be mounted above the plane of the roof on a curb constructed in accordance with the requirements for the type of construction classification, but at least four inches (102 mm) above the plane of the roof. Edges of *plastic* skylights or domes shall be protected by metal or other approved noncombustible material, or the *plastic* dome or skylight shall be shown to be able to resist ignition when exposed at the edge to a flame from a Class B brand as described in ASTM E108 listed in ***Appendix A.***

Exceptions:

1. Curbs are not required for skylights used on roofs having a minimum slope of three units vertical in 12 units horizontal (3:12) in occupancies in Use Group R-3 and on buildings with an unclassified roof covering.
2. The metal or noncombustible edge material is not required where unclassified roof coverings are permitted.

2608.3 Slope: Flat or corrugated *plastic* skylights shall slope at least four units vertical in 12 units horizontal (4:12). Dome-shaped skylights shall rise above the mounting flange a minimum distance equal to 10% of the maximum span of the dome, but not less than three inches (76 mm).

Exception: Skylights that pass the Class B Burning Brand Test specified in ASTM E108 listed in ***Appendix A.***

2608.4 Maximum area of skylight units: Each skylight unit shall have a maximum area within the curb of 100 square feet (9.30 m^2) except that the area of skylight units shall not be limited in buildings equipped throughout with an *automatic sprinkler system* in accordance with 780 CMR 906.2.1.

2608.5 Aggregate area of skylights: The aggregate area of skylights shall not exceed 33% of the floor area of the room or space sheltered by the roof in which such skylights are installed where Class C1 materials are utilized, and 25% where Class C2 materials are utilized.

Exception: The aggregate area limitations of approved *plastic* skylights shall be increased 100% beyond the limitations set forth in 780 CMR 2608.0 where the building is equipped throughout with an *automatic sprinkler system* in accordance with 780 CMR 906.2.1

2608.6 Separation: Skylights shall be separated from each other by a distance of not less than four feet (1219 mm) measured in a horizontal plane, except that the separation shall not be required where the building is equipped throughout with an *automatic sprinkler system* in accordance with 780 CMR 906.2.1.

2608.7 Location: Where exterior wall openings are required to be *protected* by 780 CMR 705.0, a skylight shall not be installed within six feet (1829 mm) of such exterior wall.

2608.8 Combinations of roof panels and skylights: Combinations of *plastic* roof panels and skylights shall be subject to the area and percentage limitations and separation requirements applicable to roof panel installations.

NON-TEXT PAGE

CHAPTER 27

ELECTRIC WIRING, EQUIPMENT AND SYSTEMS

(780 CMR 27 is Entirely Unique to Massachusetts)

2701.0: *M.G.L. c. 143, § 3L, provides that all installation, repair and maintenance of wiring and electrical fixtures used for light, heat and power purposes in buildings and structures shall be in conformance with the Massachusetts Electrical Code (527 CMR 12.00) listed in Appendix A and promulgated by the Board of Fire Prevention Regulations of the Commonwealth of Massachusetts, Department of Fire Services.*

NON-TEXT PAGE

CHAPTER 28

MECHANICAL SYSTEMS

780 CMR 2801.0

2801.1 Scope: The provisions of 780 CMR 28 shall control the construction, inspection and maintenance of all mechanical equipment and systems with respect to structural strength, fire safety and operation.

Note: Also see 780 CMR 9, 12 and 13.

2801.2 Mechanical code: All mechanical equipment and systems shall be constructed, installed and maintained in accordance with the BOCA National Mechanical Code listed in *Appendix A*.

2801.2.1 Heating, Pumping, Process Piping and Refrigeration Systems: Heating, pumping, process piping and refrigeration systems shall be installed by contractors and personnel appropriately licensed in the Commonwealth of Massachusetts (Installing Contractor). Engineered designs and specifications prepared by Registered Professional Engineers shall identify systems requiring compliance with appropriate sections of M.G.L. c. 146 and 528 CMR. Shop drawings and design layout prepared by licensed installing contractors shall note the name(s), license number(s) and license expiration date(s) of the contractor(s) installing the heating, pumping, process piping and refrigeration systems. (See Installing Contractor Definition 780 CMR 202.0).

2801.2.2 Location of Air Intakes and Outlets:

2801.2.2.1 Location of Outdoor Air Intakes: Outdoor air intakes shall be located such that the distance measured from the closest point of the intake opening to the object, or point, listed in Table 2801.2.2.1 exceeds the minimum separation distance listed in Table 2801.2.2.1.

Exception: Shorter separation distances are acceptable if it can be shown that an equivalent rate of introduction of outdoor air contaminants will be attained using an alternative design, and if approved by the authority having jurisdiction.

Table 2801.2.2.1

AIR INTAKE MINIMUM SEPARATION DISTANCE

Object	Minimum Distance, ft
Property line	3
Garage entry, loading area, or drive-in queue (Note 1)	25
Driveway or street	10
Limited access highway	25
Mantles or ledges (Note 2)	3
Landscaped grade (Note 3, 4)	6
Roof or grade (Note 4)	0.75
Cooling towers (Note 5)	15

Note 1: These areas are likely locations where vehicles will be paused and idling, such as while paying parking fees or waiting for traffic in the case of the garage entry, while loading or unloading materials in case of the loading area, or waiting in line for drive-in restaurant or bank service in the case of the drive-in queue.

Larger separation distances may be needed if the intake is located directly above the likely location of idling vehicles.

Note 2: Applies to mantles or ledges that are sloped less than 45 degrees from the horizontal and that are more than six in. wide.

Note 3: Landscaped grade is soil, lawn, shrubs, or any plant life within 1.5 ft horizontally of intake.

Note 4: Intake must be at least eight in. above the average maximum snow depth at the intake.

Note 5: Applies to closest wetted surface of tower, such as intake or basin. See Section 5.5 for separation distance from tower discharge.

2801.2.2.2 Exhaust outlets and air intakes: Exhaust air and vent outlets shall be located no closer to outdoor air intakes than the minimum separation distance determined in accordance with Equation 2801.2.2.2:

Equation 2801.2.2.2

$$S = 0.09 \times Q^{0.5} (D^{0.5} - V/400)$$

Where:

Q = Exhaust air volume, cfm. The value used in Equation 2801.2.2.2 shall not be less than 150 cfm nor exceed 3000 cfm regardless of actual volume. For gravity vents such as plumbing vents, use an exhaust rate of 150 cfm. For flue vents from fuel burning appliances, assume a value of 250 cfm per million Btu/hr of combustion input (or obtain actual rates from the combustion appliance manufacturer).

D = Dilution factor:

1. Dilution factor shall be five for exhaust air outlets from spaces without unusual sources of contaminants.
2. Dilution factor shall be ten for exhaust air outlets with mild contaminants including copy rooms, printer rooms, dining area and break rooms, cafeterias, laundry rooms, locker rooms and residential kitchens and bathrooms.
3. Dilution factor shall be 15 for plumbing vents and exhaust air outlets from spaces with significant contaminant intensity including public toilets or toilets in health care facilities, commercial kitchens, laboratories, dry-cleaning establishments and indoor swimming pools.
4. Dilution factor shall be 25 for air with noxious or toxic fumes or gases including spray paint booths, garages, tunnels, kitchen grease

hoods, laboratory fume hoods, chemical storage, refrigerating machinery rooms, soiled laundry storage and natural gas and propane burning appliance vents.

5. Dilution factor shall be 50 for air with a high concentration of dangerous particles including vents from fuel burning appliances other than natural gas or propane burning appliances, uncleaned fume hood exhaust, evaporative condenser and cooling tower outlets.

V = Exhaust air discharge velocity, fpm . V shall have a positive value when the exhaust is directed away from the object, and shall have a negative value when the exhaust is directed towards the object. V shall be set to 0 in Equation 2801.2.2.2 for vents from gravity (atmospheric) fuel fired appliances, plumbing vents, and other non-powered exhausts, or if the exhaust discharge is covered by a cap or other device that dissipates the exhaust air stream. For hot gas exhausts such as combustion products, an effective additional 500 fpm upward velocity shall be added to the actual discharge velocity.

2801.2.2.3 Exhaust outlets and windows: Exhaust air and vent outlets shall be located no closer to operable windows than one-half the minimum separation distance determined in accordance with Equation 2801.2.2.2.

For exhaust air with a dilution factor greater than ten the horizontal distance between outlets and operable windows shall be at least the minimum separation distance determined in accordance with Equation 2801.2.2.2.

2801.2.2.4 Exhaust outlets and property lines: Exhaust air outlets shall be located at least ten feet from property lines for air with a dilution factor greater than ten, in accordance with Equation 2801.2.2.2.

Exception: exhausts located ten ft. or more above grade where the property line abuts a street or public way.

780 CMR 2802.0 CONSTRUCTION DOCUMENTS

2802.1 General: The *construction documents* for the installation, repair, extension or removal of any mechanical equipment or system shall be submitted in accordance with 780 CMR 110.0 and a building permit shall be secured prior to the commencement of any work.

2802.2 Matter covered: The *construction documents* shall show in sufficient detail all applicable features and clearances of the appliances and systems, including: size and type of apparatus; construction of flue, stack or chimney; stack connections; type of fuel; method of operation; and the method of compliance with all regulations for the class and type of equipment installed.

2802.3 Details: An application for a building permit for mechanical systems shall be accompanied by *construction documents* complying with the provisions of the mechanical code listed in *Appendix A* before a permit shall be issued for the mechanical equipment or system. The *construction documents* shall be drawn to a scale of not less than ⅛ inch to the foot (1:100). and shall show the location and arrangement of all equipment and distribution elements including safeties and pressure-controlling devices.

Note: Also see 780 CMR 2803.1.

780 CMR 2803.0 FEES

2803.1 General: Fees for mechanical work, shall be included in the building permit application (see 780 CMR 114.0).

780 CMR 2804.0 INSPECTIONS AND TESTS

2804.1 Inspection: All mechanical equipment and systems requiring a permit shall be inspected in accordance with the BOCA National Mechanical Code listed in *Appendix A* and shall not be placed in operation until having been tested and approved.

2804.2 Concealment: It shall be unlawful for owners, contractors or workers to lath over or in any way conceal any piping, outlet boxes or other parts of the mechanical equipment or system requiring a permit until an inspection has been made thereof and due notice has been given that the work has been approved.

2804.3 Defects and repairs: Upon inspection or reinspection of a mechanical system, any defects or deficiencies which require repair to insure safe operation shall be rectified before the system is placed in service.

2804.4 Power to deem unsafe: A system or any part thereof that is found to be unsafe to life or property, shall be deemed unsafe and shall not be restored to service until such system has been made safe and approved.

780 CMR 2805.0 PLENUMS

2805.1 General: The term "plenum" shall mean an enclosed portion of the building structure which forms part of an air distribution system and is designed to allow the movement of air. Supply, return, exhaust, relief and *ventilation* air plenums shall be limited to uninhabited crawl spaces, areas above a ceiling or below the floor, or *attic* spaces and mechanical equipment rooms. The location of supply and return air plenums shall also comply with 780 CMR 1005.7. Plenums shall be limited to one *fire area*. Fuel-fired equipment shall not be installed within a plenum. In buildings of Type 1 or 2 construction, all plenums shall be noncombustible and shall comply with 780 CMR 2805.2. In build-

#330

THE COMMONWEALTH OF MASSACHUSETTS
William Francis Galvin
Secretary of the Commonwealth

Regulation Filing *To be completed by filing agency*

CHAPTER NUMBER: 780 CMR 34

CHAPTER TITLE: Repair, Alteration, Addition, and Change of Use of Existing Structures

AGENCY: Department of Public Safety / Board of Building Regulations and Standards

SUMMARY OF REGULATION: *State the general requirements and purposes of this regulation.*

These Regulations dictate the structural design requirements for totally or partially historic buildings.

REGULATORY AUTHORITY: c. 802 of the acts of 1972, as amended and MGL c.143 Sections 93-100

AGENCY CONTACT: Robert Anderson PHONE: 617-727-3200

ADDRESS: One Ashburton Plc, Rm 1301, Boston, MA 02108

Compliance with M.G.L. c. 30A

EMERGENCY ADOPTION - *If this regulation is adopted as an emergency, state the nature of the emergency.*

PRIOR NOTIFICATION AND/OR APPROVAL - *If prior notification to and/or approval of the Governor, Legislature or others was required, list each notification, and/or approval and date, including notice to the Local Government Advisory Commission.*

Local Government Notice on 4/21/04 and 10/18/04, respectively

PUBLIC REVIEW- *M.G.L. c. 30A. §§ 2 and/or 3 requires notice of the hearing or comment period be filed with the Secretary of the Commonwealth, published in appropriate newspapers, and set to persons to whom specific notice must be given at least 21 days prior to such hearing or comment period.*

Date of public hearing or comment period: Comment Period thru 6/11/04 and 12/9/04 respectively

FISCAL EFFECT - *Estimate the fiscal effect of the public and private sectors.*

For the first and second year: No estimate available but recommended by Task Force on Fire/Bldg. Safety, or required by c. 304 of the Acts of 2004 or other

For the first five years: No estimate available but recommended by Task Force on Fire/Bldg. Safety, or required by c. 304 of the Acts of 2004 or other

No fiscal effect: No estimate available but recommended by Task Force on Fire/Bldg. Safety, or required by c. 304 of the Acts of 2004 or other

SMALL BUSINESS IMPACT - *State the impact of this regulation on small business. Include a description of reporting, record keeping and other compliance requirements as well as the appropriateness of performance versus design standards and whether this regulation duplicates or conflicts with any other regulation. If the purpose of this regulation is to set rates for the state, this section does not apply.*

No estimate available but recommended by Task Force on Fire/Bldg. Safety, or required by c. 304 of the Acts of 2004 or other

CODE OF MASSACHUSETTS REGULATIONS INDEX - *List key subjects that are relevant to this regulation*:

780 CMR 34, Section 3400.3 - structural requirements, historic buildings, wind load requirements, seismic load requirements; Section 3404.12 - automatic fire suppression systems, nightclubs, sprinkler requirements

PROMULGATION - *State the action taken by this regulation and its effect on existing provisions of the Code of Massachusetts Regulations (CMR) to repeal, replace or amend. List by CMR number:*

Amends 780 CMR 3400.3(10), 780 CMR 3404.12

ATTESTATION - *The regulation described herein and attached hereto is a true copy of the regulation adopted by this agency.* ATTEST:

SIGNATURE: DATE: 8/26/05

Publication - *To be completed by the Regulations Division*

MASSACHUSETTS REGISTER NUMBER: #1034 DATE: 9/9/05

EFFECTIVE DATE: 9/9/05

CODE OF MASSACHUSETTS REGULATIONS

Remove these pages:	*Insert these pages:*
445, 446	445, 446
449, 450	449, 450

A TRUE COPY ATTEST

William Francis Galvin

WILLIAM FRANCIS GALVIN
SECRETARY OF THE COMMONWEALTH

DATE 8/26/05 CLERK

ings of Type 3, 4 or 5 construction, noncombustible plenums in accordance with 780 CMR 2805.2, combustible plenums in accordance with 780 CMR 2805.3, and stud and joist space plenums in accordance with 780 CMR 2805.4, shall be permitted.

2805.2 Noncombustible plenums: Plenums shall be constructed with noncombustible material. Combustible material shall not be exposed within a plenum except as permitted in 780 CMR 2805.2.1 through 2805.2.6.

2805.2.1 Pipe: Pipe shall be noncombustible except that plastic fire *sprinkler* piping in wet pipe systems shall be permitted where the piping has a peak optical density not greater than 0.50, an average optical density not greater than 0.15 and a flame spread not greater than 5.0 feet (1524 mm) when tested in accordance with UL 1887 listed in ***Appendix A***. Piping shall bear the *label* of an *approved agency*.

2805.2.2 Ceiling and thermal material: Thermal and acoustical materials and pipe insulation shall have a flame spread of 25 or less and a smoke-developed rating of 50 or less when tested in accordance with ASTM E84 listed in ***Appendix A***.

2805.2.3 Ducts: Rigid or flexible ducts and connectors shall conform to the mechanical code listed in ***Appendix A***.

2805.2.4 Duct coverings: Duct coverings, linings, tape and connectors shall conform to the BOCA National Mechanical Code listed in ***Appendix A***.

2805.2.5 Wire: Wire shall be low-voltage or power-limited wire or cable. Wire shall have a peak optical density not greater than 0.50, an average optical density not greater than 0.15 and a flame spread of not greater than five feet (1524 mm) when tested in accordance with UL 910 listed in ***Appendix A***. Wire shall bear the *label* of an *approved agency* and shall be marked in accordance with 527 CMR 12.00 listed in ***Appendix A***.

2805.2.6 Combustible pneumatic tubing: Combustible pneumatic tubing shall have a peak optical density not greater than 0.50, an average optical density not greater than 0.15 and a flame spread of not greater than five feet (1524 mm) when tested in accordance with UL 1820 listed in ***Appendix A,*** and shall bear the *label* of an *approved agency*.

2805.3 Combustible plenums: The plenum shall be constructed with approved material. Combustible material, pipe or wire exposed within the plenum shall be permitted.

2805.3.1 Size: Combustible plenums shall be *draftstopped* every 3,000 square feet (279 m2) in area.

Exception: Plenums shall be limited to one *fire area* without *draftstopping* in buildings equipped throughout with an *automatic sprinkler* system in accordance with 780 CMR 906.2.1.

2805.4 Stud and joist spaces: The space between studs or joists shall not be utilized as a plenum for supply air. The space between studs or joists utilized as a plenum for return air shall not be part of a required fireresistance rated assembly. Air shall be removed from one floor level only. All connections shall be *firestopped* and *draftstopped*.

780 CMR 2806.0 DRYING ROOMS

2806.1 General: A drying room or dry kiln installed within a building shall be constructed entirely of approved noncombustible materials or assemblies of such materials with the required fireresistance rating based on the fire hazard of the contents and the process, as required in 780 CMR 4.

2806.2 Piping clearance: All overhead heating pipes shall have a clearance of not less than two inches (51 mm) from combustible contents of the dryer.

2806.3 Insulation: Where the operating temperature of the dryer is 175°F (79°C) or more, metal enclosures shall be insulated from adjacent combustible materials by not less than 12 inches (305 mm) of air space, or the metal walls shall be lined with ¼-inch insulating mill board or other approved equivalent insulation.

2806.4 Fire protection: Drying rooms designed for high-hazard materials and processes, including special occupancies as provided for in 780 CMR 4, shall be protected by an approved *automatic fire suppression system* conforming to the provisions of 780 CMR 9.

780 CMR 2807.0 WASTE- AND LINEN-HANDLING SYSTEMS

2807.1 General: Waste (refuse) and linen (laundry) systems shall be installed in accordance with 780 CMR 2807.0 and the provisions of Chapters 3 and 4 of NFiPA 82 listed in ***Appendix A***.

Exception: Systems serving and contained within a single *dwelling unit*.

2807.2 Waste and linen chute enclosures: A *shaft* containing a refuse or linen chute shall not be used for any other purpose and shall be enclosed in accordance with 780 CMR 710.0. All openings into the *shaft*, including those from access rooms and termination rooms, shall be protected with approved

NON-TEXT PAGE

fireresistance rated assemblies. Such opening protectives shall be self-closing or automatic-closing upon detection of smoke, except that a heat-activated device for closing the opening protective between the *shaft* and the termination room is permitted.

2807.3 Waste and linen chute access rooms: Access openings for waste and linen chutes shall be located in rooms or compartments which are completely enclosed by *fire separation assemblies* having a fireresistance rating of not less than one hour; and openings into the access rooms shall be protected by *fire doors* that comply with 780 CMR 716.0. Access openings to waste and linen chutes shall not be located in *exit access corridors* or *exit* enclosures.

2807.4 Termination room: Waste and linen chutes shall discharge into an enclosed room that is completely separated from the remainder of the building by *fire separation assemblies* having a fireresistance rating of not less than one hour; and openings into the termination room shall be protected by *fire doors* that comply with 780 CMR 716.0. Waste chutes shall not terminate in an incinerator room.

2807.5 Incinerator room: Where located within a building, incinerators shall be enclosed within a room that is separated from the remainder of the building by *fire separation assemblies* having a fireresistance rating of not less than two hours; and openings into the incinerator room shall be protected by *fire doors* that comply with 780 CMR 716.0.

2807.6 Automatic fire suppression: An approved *automatic fire suppression system* shall be installed at the top and at alternate floor levels in a waste or linen chute and in the termination and incinerator rooms.

780 CMR 2808.0 REFUSE VAULTS

2808.1 Refuse vault enclosures: A vault for receiving combustible refuse from an exhaust system shall be enclosed with *fire separation assemblies* having not less than a three-hour fireresistance rating.

2808.2 Openings to boiler rooms: The opening between a vault and a boiler room shall not exceed nine square feet (0.84 m^2) in area and shall be located at least eight feet (2438 mm) from the firing door of the boiler, and the bottom of the opening shall not be less than six inches (152 mm) above the boiler room floor. All openings shall be equipped with *fire doors* having a fire protection rating of not less than 1½ hours and complying with 780 CMR 716.0.

2808.3 Location: Where located within a building, a refuse vault shall extend above the roof or shall be directly vented to the outer air with ducts that comply with the BOCA National Mechanical Code listed in *Appendix A*.

2808.4 Fire protection: A vault for combustible refuse which exceeds 360 cubic feet (10 m^3) in volume shall be protected by an approved *automatic fire suppression system* that conforms to 780 CMR 9.

780 CMR 2809.0 MEDICAL GASES

2809.1 Nonflammable medical gases: Nonflammable medical gas systems shall be designed and installed in accordance with Chapter 4 of NFiPA 99 listed in *Appendix A*.

2809.2 Anesthetic systems: Inhalation anesthetic systems shall be designed and installed in accordance with Chapters 3 and 4 of NFiPA 99 listed in *Appendix A*.

780 CMR 2810.0 OXYGEN SYSTEMS

2810.1 General: Nonmedical oxygen systems shall be designed and installed in accordance with NFiPA 50 and NFiPA 51 listed in *Appendix A*.

780 CMR 2811.0 EXISTING BUILDINGS

2811.1 Unsafe orders: All existing mechanical equipment and systems shall be maintained and operated in accordance with the requirements of this code and the BOCA National Mechanical Code listed in *Appendix A*. Any such equipment which does not comply with the requirements, and the operation of which is deemed unsafe to the building occupants, shall be *altered* as ordered by the code official to secure adequate safety.

Note: Also see 780 CMR 3400.6.

780 CMR 2812.0 POWER VENTERS

2812.1 Power vented systems used for the venting of comfort heating and/or comfort cooling appliances: *Power venters are a portion of a venting system using a fan or other mechanical means to cause the removal of flue or vent gases under positive static vent pressure. Power venting of comfort heating and/or comfort cooling appliances may be accomplished via the use of power venting systems that are separately listed systems or are an integral part of the listed heating or cooling appliances. Such listed systems are equipment that have been tested for intended design conditions by established and recognized agencies regularly engaged in conducting tests or furnishing testing/listing services. Such listed equipment will typically bear a plate, label or other means of identification indicating the listing agency, conditions of operation and other pertinent information.*

2812.1.1 Regulations of the Specialized Codes ***impacting*** *the acceptable design, installation,* ***operation*** *and maintenance of power vented* ***equipment****: The Specialized Codes (780 CMR 101.5) including 248 CMR: BOARD OF STATE EXAMINERS OF PLUMBERS AND GAS FITTERS, and 527 CMR: BOARD OF FIRE PREVENTION REGULATIONS, and not enforced by Building Officials but rather enforced by Plumbing/Gas Inspectors and Fire Service Personnel, respectively, have specific criteria imposed on power vented appliances beyond those regulations included herein.*

2812.2 *Automatic safe shutoff: Power venters shall operate in such a manner and be electrically connected to the comfort heating and/or comfort cooling appliances in such a way as to prevent the operation of such appliances when the power venter is not in operation or is not providing sufficient draft for the appliance being vented.*

2812.3 *Installation of power vented equipment: Power vented equipment shall be installed in accordance with the manufacturer's installation manual and instructions (typically, only personnel trained in the installation of such equipment are accepted by the manufacturer as qualified to install). Power venters shall be selected to match the venting requirements of the equipment being vented in accordance with the manufacturers' requirements.*

2812.4 *Termination: The vent system shall terminate so that proper clearances are maintained in accordance with the requirements of 248 CMR or 527 CMR when applicable or in accordance with the manufacturer's listed requirements when 248 CMR or 527 CMR are not applicable.*

2812.5 *Other applications of power exhausters: For applications of power exhausters for other than the venting of comfort heating appliances and/or comfort cooling appliances, the requirements of the BOCA Mechanical Code, listed in Appendix A, shall apply, as well as any additional regulatory criteria set forth in any of the Specialized Codes.*

2813.0 SOLID FUEL-FIRED APPLIANCES

2813.1 Solid fuel-fired appliances, general*: For requirements addressing solid fuel-fired appliances see 780 CMR 3610.6.*

CHAPTER 29

PLUMBING SYSTEMS

(780 CMR 29 is Entirely Unique to Massachusetts)

2901.0 *M.G.L. c. 142, § 13 provides that all construction, alteration, repair and inspection of plumbing and gasfitting shall be in conformance with the Massachusetts State Plumbing Code (248 CMR 2.00) and the Massachusetts Fuel Gas Code (248 CMR 3.00 through 8.00), listed in Appendix A, and promulgated by the Board of State Examiners of Plumbers and Gasfitters.*

2901.1 Other Laws and Regulations: Fire protection, heating, pumping, process piping and refrigeration systems are required to be installed by contractors and personnel appropriately licensed in the Commonwealth of Massachusetts (Installing Contractor). (See Installing Contractor Definition 780 CMR, 202.0).

NON-TEXT PAGE

CHAPTER 30

ELEVATORS

(This Chapter is Entirely Unique to Massachusetts)

780 CMR 3001.0 GENERAL

3001.1 M.G.L. c. 143, § 69 as amended, provides that elevators and similar equipment shall conform to the Elevator Regulations 524 CMR as listed in Appendix A and promulgated by the Board of Elevator Regulations of the Commonwealth of Massachusetts, Department of Public Safety.

3001.2 Shaft construction shall be in accordance with the applicable provisions of 780 CMR.

NON-TEXT PAGE

CHAPTER 31

SPECIAL CONSTRUCTION

780 CMR 3101.0 GENERAL

3101.1 Scope: In addition to the general requirements of 780 CMR governing the design and construction of all structures, the provisions of 780 CMR 31 shall control the special structures and construction features as herein provided.

780 CMR 3102.0 SIGNS

3102.1 General: The provisions of 780 CMR 3102.0 shall govern the construction, *alteration*, repair and maintenance of all *signs* together with the associated appurtenant and auxiliary devices in respect to structural and fire safety.

3102.2 Definitions: The following words and terms shall, for the purposes of 780 CMR 3102.0 and as used elsewhere in 780 CMR, have the meanings shown herein.

Sign: Any fabricated sign or outdoor display structure, including its structure, consisting of any letter, figure, character, mark, point, plane, marquee sign, design, poster, pictorial, picture, stroke, stripe, line, trademark, reading matter or illuminating device, which is constructed, attached, erected, fastened or manufactured in any manner so that the same shall be used for the attraction of the public to any place, subject, person, firm, corporation, public performance, article, machine or merchandise, and displayed in any manner out of doors for recognized advertising purposes.

Closed sign: A *sign* in which more than 50% of the entire area is solid or tightly enclosed or covered.

Ground sign: A *sign* supported by uprights or braces in or upon the ground surface.

Marquee sign: A *sign* attached to or hung from a marquee, canopy or other covered structure, projecting from and supported by the building and extending beyond the building wall, building line or *street lot line*.

Open sign: A *sign* in which at least 50% of the enclosed area is uncovered or open to the transmission of wind.

Portable sign: A *sign*, usually of a temporary nature, not securely anchored to the ground or to a building or structure and which obtains some or all of its structural stability with respect to wind or other normally applied forces by means of its geometry or character.

Projecting sign: A display *sign* which is attached directly to the building wall, and which extends more than 15 inches (381 mm) from the face of the wall.

Roof sign: A *sign* which is erected, constructed and maintained above the roof of the building.

Temporary sign: A *sign* constructed of cloth, fabric or other lightweight temporary material with or without a structural frame intended for a limited period of display; including decoration displays for holidays or public demonstrations.

Wall sign: A *sign* which is painted on or attached directly to a fence or on the surface of masonry, concrete, frame or other approved building walls, and which extends not more than 15 inches (381 mm) from the face of the fence or wall.

3102.3 Zoning law: Where more restrictive in respect to location, purpose, size or height of *signs*, the limitations of *zoning* laws that affect occupancy of land shall take precedence over the regulations of 780 CMR.

In the absence of approved rules governing details of construction, the provisions of the applicable standards listed in Appendix A shall be deemed to conform to the requirements of 780 CMR unless otherwise specified in 780 CMR 31.

Outdoor advertising subject to 711 CMR 3.00: Control and Restriction of Billboards, Signs and Other Advertising Devices (the Outdoor Advertising Board) as listed in Appendix A, and in accordance with Massachusetts General Laws Annotated, as amended, requires approval of said Board prior to the issuance of a permit.

3102.4 Permits and construction documents: Permits for *signs* shall be required as specified in 780 CMR 3102.4.1 and 3102.4.2 except as provided for in 780 CMR 3102.4.3. *Construction documents* shall be prepared and filed in accordance with 780 CMR 3102.4.4 and 3102.4.5.

3102.4.1 New signs: A new *sign* shall not hereafter be erected, constructed, *altered* or maintained except as provided for herein, and until a permit has been issued by the code official.

3102.4.2 Alterations: A *sign* shall not be enlarged or relocated unless such *sign* conforms to the provisions of 780 CMR 3102.0 for new *signs*, or until a proper permit has been secured. The changing of movable parts of an approved *sign* that is designed for such changes, or the repainting or reposting of display matter, shall not be deemed an *alteration*, provided that the conditions of the original approval and the requirements of 780 CMR 3102.0 are not violated.

3102.4.3 Permit exemptions: A permit shall not be required for the *signs* specified in 780 CMR 3102.4.3.1 through 3102.4.3.5. Such exceptions, however, shall not be construed to relieve the owner of the *sign* from responsibility for the *sign's* erection and maintenance in a safe manner.

3102.4.3.1 Wall signs: A permit shall not be required for a *sign* painted on the surface of a fence or approved building wall, or any nonilluminated wall *sign* on a building or structure which is not more than ten square feet (0.93 m^2) in area.

3102.4.3.2 Sale or rent: A permit shall not be required for ground *signs* erected to announce the sale or rent of property, provided that such *signs* are not more than 25 square feet (2.33 m^2) in area.

3102.4.3.3 Transit directions: A permit shall not be required for the erection or maintenance of a ground *sign* designating the location of a transit line, a railroad station or other public carrier provided that such *signs* are not more than three square feet (0.28 m^2) in area.

3102.4.3.4 Street signs: A permit shall not be required for ground *signs* erected by a jurisdiction for street direction.

3102.4.3.5 Projecting signs: A permit shall not be required for a projecting *sign* not exceeding 2½ square feet (0.23 m^2) of display surface.

3102.4.3.6 Government building signs: ***Signs erected on a municipal, state or federal building which announce the name, nature of the occupancy and information as to use of, or admission to the premises.***

3102.4.4 Construction documents and owner's consent: Before any permit is issued for the erection of a *sign*, *construction documents* shall be filed with the code official showing the dimensions, materials and required details of construction, including *loads*, stresses and anchorage. The applications shall be accompanied by the *written* consent of the owner or lessee of the premises upon which the *sign* is to be erected.

3102.4.5 Identification: Every *sign* for which a permit has been issued and which is hereafter erected, constructed or maintained, shall be plainly marked with the name of the person, firm or corporation owning, erecting, maintaining or operating such *sign*. The method and location of this identification shall appear on the *construction documents* filed with the code official.

3102.5 Maintenance and inspection: *Sign* maintenance and inspection shall comply with 780 CMR 3102.5.1 through 3102.5.4.

3102.5.1 Removal: The code official is authorized to order the removal of any *sign* that is not maintained in accordance with the provisions of 780 CMR 3102.0.

3102.5.2 Maintenance: All *signs* for which a permit is required, together with all supports, braces, guys and anchors, shall be kept in repair in accordance with the provisions of 780 CMR 3102.0 and 780 CMR 1. Where not galvanized or constructed of approved corrosion-resistant noncombustible materials, *signs* shall be painted.

3102.5.3 Housekeeping: The owner or lessee of every *sign* shall maintain the immediate premises occupied by the *sign* in a clean, sanitary and healthful condition.

3102.5.4 Inspection: Every *sign* shall be subject to inspection and approval.

3102.6 General requirements: All *signs* shall be designed and constructed to comply with the provisions of 780 CMR for materials, *loads* and stresses, and with the requirements of 780 CMR 3102.6.1 through 3102.6.5.

3102.6.1 Wind load: All *signs* shall be designed and constructed to withstand wind pressure as provided for in 780 CMR 1611.12.2.

3102.6.2 Earthquake load: *Signs* designed to withstand wind pressures shall be considered capable of withstanding *earthquake loads*, except as provided for in 780 CMR 1612.0 and 1616.0.

3102.6.3 Illumination: A *sign* shall not be illuminated by other than electrical means, and electrical devices and wiring shall be installed in accordance with the requirements of 527 CMR 12.00 listed in *Appendix A*. Any open spark or flame shall not be used for display purposes unless specifically approved.

3102.6.4 Use of combustibles: The requirements of 780 CMR 3102.6.4.1 and 3102.6.4.2 shall apply to combustible material for *signs*.

3102.6.4.1 Ornamental features: Wood or approved *plastic* as provided for in 780 CMR 26, or other materials of combustible characteristics similar to wood, used for moldings, cappings, nailing blocks, letters and latticing, shall comply with 780 CMR 3102.7, and shall not be used for other ornamental features of *signs*, unless approved.

3102.6.4.2 Internally illuminated signs: Except as provided for malls in 780 CMR 402.14, where internally illuminated *signs* have *sign* facings of wood or approved combustible *plastic*, the area of such facing section shall not be more than 120 square feet (11.16 m^2) and the wiring for electric lighting shall be entirely enclosed in the *sign* cabinet with a clearance of not less than two inches (51 mm) from the facing material. The dimensional limitation of 120 square feet (11.16 m^2) shall not apply to *sign* facing sections made from flameresistant-coated fabric (ordinarily known as "flexible *sign* face *plastic*") that weighs less than 20 ounces per square yard (678 g/m^2) and which, when tested in accordance with NFiPA 701 listed in ***Appendix A*** meets the requirements of both the small-scale test and the large-scale test, or which, when tested in accordance with an approved test method, exhibits an average burn time for ten specimens of two seconds or less and a burning extent of 15 centimeters or less.

3102.6.5 Animated devices: *Signs* that contain moving sections or ornaments shall have fail-safe provisions to prevent the section or ornament from releasing and falling or shifting its center of gravity more than 15 inches (381 mm). The fail-safe device shall be in addition to the mechanism and the mechanism's housing which operate the movable section or ornament. The fail-safe device shall be capable of supporting the full dead weight of the section or ornament when the moving mechanism releases.

3102.7 Ground signs: The structural frame of ground *signs* shall not be erected of combustible materials to a height of more than 35 feet (10668 mm) above the ground. In all locations, where constructed entirely of noncombustible material, ground *signs* shall not be erected to a height of greater than 100 feet (30480 mm) above the ground. Greater heights are permitted where approved and located so as not to create a hazard or danger to the public.

3102.8 Roof signs: Roof *signs* shall comply with 780 CMR 3102.8.1 through 3102.8.4.

3102.8.1 Materials: All roof *signs* shall be constructed entirely of metal or other approved noncombustible material except as provided for in 780 CMR 3102.6.4. Provisions shall be made for electric grounding of all metallic parts. Where combustible materials are permitted in letters or other ornamental features, all wiring and tubing shall be kept free and insulated therefrom.

3102.8.2 Bottom clearance: There shall be a clear space of not less than six feet (1829 mm) between the lowest part of the *sign* and the roof level, except for necessary structural supports.

3102.8.3 Closed signs: A closed roof *sign* shall not be erected to a height greater than 50 feet (15240 mm) above the roof of buildings of Types 1 and 2 construction, nor more than 35 feet (10668 mm) above the roof of buildings of Types 3, 4 and 5 construction.

3102.8.4 Open signs: An open roof *sign* shall not exceed a height of 100 feet (30480 mm) above the roof of buildings of Types 1 and 2 construction; and not more than 60 feet (18288 mm) above the roof of buildings of Types 3, 4 and 5 construction.

3102.9 Wall signs: Wall *signs* shall comply with 780 CMR 3102.9.1 and 3102.9.2.

3102.9.1 Materials: Wall *signs* which have an area exceeding 40 square feet (3.72 m^2) shall be constructed of metal or other approved noncombustible material, except for nailing rails and as provided for in 780 CMR 3102.6.4.

3102.9.2 Extension: Wall *signs* shall not be erected to extend above the top of the wall, nor to extend beyond the ends of the wall to which the *signs* are attached unless such *signs* conform to all of the requirements for roof *signs*, projecting *signs* or ground *signs*.

3102.10 Projecting signs: Projecting *signs* shall comply with 780 CMR 3102.10.1 through 3102.10.4.

3102.10.1 Materials: Projecting *signs* shall be constructed entirely of metal or other approved noncombustible material except as provided for in 780 CMR 3102.6.4.

3102.10.2 Maximum projection: A projecting *sign* shall not extend beyond a vertical plane that is two feet (610 mm) inside the curb line.

3102.10.3 Clearance: A vertical clearance of not less than eight feet (2438 mm) shall be provided below all parts of projecting *signs*.

3102.10.4 Additional loads: Projecting *sign* structures which will be used to support an individual on a ladder or other servicing device – whether or not specifically designed for the servicing device – shall be capable of supporting the anticipated additional *load*, but not less than a 100-pound (45.4 kg) concentrated horizontal *load* and a 300-pound (136.2 kg) concentrated vertical *load* applied at the point of assumed or most eccentric *loading*. The building component to which the projecting *sign* is attached shall also be designed to support the additional *loads*.

3102.11 Marquee signs: Marquee *signs* shall comply with 780 CMR 3102.11.1 through 3102.11.3.

3102.11.1 Materials: Marquee *signs* shall be constructed entirely of metal or other approved noncombustible material except as provided for in 780 CMR 3102.6.4.

3102.11.2 Attachment: Marquee *signs* shall be attached to approved marquees that are constructed in accordance with 780 CMR 3203.11.

3102.11.3 Dimensions: Marquee *signs* shall not project beyond the perimeter of the marquee.

3102.12 Temporary signs: Temporary *signs* shall comply with 780 CMR 3102.12.1 through 3102.12.4.

3102.12.1 Banner and cloth signs: Temporary *signs* and banners which are attached to or suspended from a building, and which are constructed of cloth or other combustible material, shall be constructed in an approved manner and shall be securely supported. Such *signs* and banners shall be removed as soon as torn or damaged, and not later than 60 days after erection. Permits for temporary *signs* that are suspended from or attached to a canopy or marquee shall be limited to a period of ten days.

3102.12.2 Maximum size: Temporary *signs* of combustible construction shall not be more than 10 feet (3048 mm) in one dimension nor more than 500 square feet (46.5 m^2) in area.

3102.12.3 Supports: Where more than 100 square feet (9.3 m^2) in area, temporary *signs* and banners shall be constructed and fastened to supports that are capable of withstanding the design *loads* listed in 780 CMR 1610.0.

3102.12.4 Special permits: Temporary *signs* used for holidays, public demonstrations or promotions of civic welfare or charitable purposes, which extend across streets or other public spaces shall be subject to special approval of the authority having jurisdiction.

3102.13 Illuminated signs: Illuminated *signs* shall comply with 780 CMR 3102.13.1 through 3102.13.3.

3102.13.1 Certificates: All electrically illuminated *signs* shall be certified as to electric wiring and devices by the agency having jurisdiction, and all wiring and accessory electrical equipment shall conform to the requirements of 527 CMR 12.00 listed in ***Appendix A***.

3102.13.2 Additional permits: Electrical permits shall be issued for the erection or maintenance of illuminated *signs*.

3102.13.3 Relettering signs: The requirements of 780 CMR 3102.13 shall not apply to the relettering of illuminated *signs*, except where such relettering requires a change of wiring or piping of the *sign*.

3102.14 Portable signs: Portable *signs* shall conform to all requirements for ground, roof, projecting, flat and temporary *signs* where such *signs* are used in a similar capacity. The requirements of 780 CMR 3102.14 shall not be construed to require portable *signs* to have connections to surfaces, tie-downs or foundations where provisions are made by temporary means or configuration of the structure to provide stability for the expected duration of the installation.

3102.14.1 Electrical: Portable *signs* that require electrical service shall have a positive connecting device on the *sign*. Electrical service lines to the *sign* shall be protected from damage from all anticipated traffic.

780 CMR 3103.0 MEMBRANE STRUCTURES

3103.1 General: The provisions of 780 CMR 3103.0 shall apply to air-supported, air-inflated, *membrane*-covered cable and *membrane*-covered frame structures, collectively known as *membrane* structures, erected for a period of 90 days or longer. Those erected for a shorter period of time shall comply with the applicable provisions of the fire prevention code, 527 CMR, listed in ***Appendix A*** and 780 CMR 3104.0. *Membrane* structures covering water storage facilities, water clarifiers, water treatment plants, sewage treatment plants and similar facilities not used for human occupancy, are required to meet only the requirements of 780 CMR 3103.3.2 and 3103.6.

3103.2 Definitions: The following words and terms shall, for the purposes of 780 CMR 3103.0 and as used elsewhere in 780 CMR, have the meanings shown herein.

Membrane: As it pertains to membrane structures, a thin, flexible, impervious material capable of being supported by an air pressure of 1.5 inches of water column (373 P).

Membrane structures

Air-inflated structure: A building where the shape of the structure is maintained by air pressurization of cells or tubes to form a barrel vault over the usable area. Occupants of such a structure do not occupy the pressurized area used to support the structure.

Air-supported structure: A building wherein the shape of the structure is attained by air pressure and occupants of the structure are within the elevated pressure area. Air-supported structures are of two basic types:

Double skin: Similar to a single skin, but with an attached liner that is separated from the outer skin and provides an air space which serves for insulation, acoustic, aesthetic or similar purposes.

Single skin: Where there is only the single outer skin and the air pressure is directly against that skin.

Cable-restrained, air-supported structure: A structure in which the uplift is resisted by cables or webbings which are anchored to either foundations or dead men. Reinforcing cable or webbing is attached by various methods to the membrane or is an integral part of the *membrane*. This is not a cable-supported structure.

Membrane-covered cable structure: A nonpressurized structure in which a mast and cable system provides support and tension to the *membrane* weather barrier and the *membrane* imparts structural stability to the structure.

Membrane-covered frame structure: A nonpressurized building wherein the structure is composed of a rigid framework to support tensioned *membrane* which provides the weather barrier.

Noncombustible membrane structure: A *membrane* structure in which the *membrane* and all component parts of the structure are noncombustible.

Tent: Any structure, enclosure or shelter which is constructed of canvas or pliable material supported in any manner except by air or the contents it protects.

3103.3 Construction requirements: Construction of *membrane* structures shall comply with 780 CMR 3103.3.1 through 3103.3.5.

3103.3.1 Type of construction: All noncombustible *membrane* structures shall be classified as Type 2C Noncombustible frame- or cable-supported structures covered by an approved *membrane* in accordance with 780 CMR 3103.3.2 shall be classified as Type 2C construction. Heavy timber frame-supported structures covered by an approved *membrane* in accordance with 780 CMR 3103.3.2 shall be classified as Type 3B construction. A noncombustible *membrane* structure that is used exclusively as a roof and is located more than 20 feet (6096 mm) above any floor, balcony or gallery, is deemed to comply with the roof construction requirements for Type 1 and Type 2 construction, provided that such a structure complies with the requirements of 780 CMR 3103. All other *membrane* structures shall be classified as Type 5B construction.

3103.3.2 Membrane material: *Membranes* shall be either noncombustible as defined by 780 CMR 704.4, or flameresistant as determined in accordance with both the small-scale and large-scale tests in NFiPA 701 listed in ***Appendix A***.

> **Exception**: *Plastic* less than 20 mil (500 µm) in thickness, used in greenhouses where occupancy by the general public is not permitted and for aquaculture pond covers, is not required to be flameresistant.

3103.3.3 Applicability of other provisions: Except as otherwise specifically required by 780 CMR 3103.3, *membrane* structures shall meet all applicable provisions of 780 CMR. The *membrane* shall meet the roof covering requirements of 780 CMR 1506.0.

3103.3.4 Allowable floor areas: The *area* of a *membrane* structure shall not exceed the limitations set forth in Table 503, except as provided for in 780 CMR 506.0.

3103.3.5 Maximum height: *Membrane* structures shall not exceed one story nor shall such structures exceed the *height* limitations in feet set forth in Table 503.

> **Exception**: Noncombustible *membrane* structures that serve as roof construction only.

3103.4 Inflation systems: Air-supported and air-inflated structures shall be provided with primary and auxiliary inflation systems to meet the minimum requirements of 780 CMR 3103.4.1 and 3103.4.2.

3103.4.1 Equipment requirements: The inflation system shall consist of one or more blowers and shall include provisions for automatic control to maintain the required inflation pressures. The system shall be so designed as to prevent overpressurization of the system.

In addition to the primary inflation system, in buildings exceeding 1,500 square feet (140 m^2) in *area*, an auxiliary inflation system shall be provided with sufficient capacity to maintain the inflation of the structure in case of primary system failure. The auxiliary inflation system shall operate automatically when there is a loss of internal pressure and when the primary blower system becomes inoperative.

Blower equipment shall meet the following requirements:

1. Blowers shall be powered by continuous-rated motors at the maximum power required for any flow condition as required by the structural design.
2. Blowers shall be provided with inlet screens, belt guards and other protective devices as required by the code official to provide protection from injury.
3. Blowers shall be housed within a weather-protecting structure.
4. Blowers shall be equipped with backdraft check dampers to minimize air loss when inoperative.
5. Blower inlets shall be located to provide protection from air contamination. The location of inlets shall be approved.

3103.4.2 Standby power: Wherever an auxiliary inflation system is required, an approved standby power-generating system shall be provided. The system shall be equipped with a suitable means for automatically starting the generator set upon failure of the normal electrical service and for automatic transfer and operation of all of the required electrical functions at full power within 60 seconds of such service failure. Standby power shall be capable of operating independently for a minimum of four hours.

3103.5 Support provisions: A system capable of supporting the *membrane* in the event of deflation shall be provided for in all air-supported and air-inflated structures having an occupant load of more than 50 or where covering a swimming pool regardless of occupant load. The support system shall be capable of maintaining *membrane* structures used as a roof for Type 1 or Type 2 construction not less than 20 feet (6096 mm) above floor or seating areas. The support system shall be capable of maintaining all other *membranes* at least seven feet (2134 mm) above the floor, seating area or surface of the water.

3103.6 Engineering design: All *membrane* structures shall be structurally designed in accordance with approved criteria that are developed by a *registered design professional*.

780 CMR 3104.0 TEMPORARY STRUCTURES

3104.1 General: The provisions of 780 CMR 3104.0 shall apply to tents, *membrane* structures and other structures erected for a period of less than 180 days. Those erected for a longer period of time shall comply with 780 CMR 3103.0 or with all applicable sections of 780 CMR where 780 CMR 3103.0 is not applicable.

3104.1.1 Permit required: All temporary structures that cover an *area* in excess of 120 square feet (11.16 m^2), including all connecting *areas* or spaces with a common *means of egress* or entrance which are used or intended to be used for the gathering together of ten or more persons, shall not be erected, operated or maintained for any purpose without obtaining a permit from the code official. Tents used exclusively for recreational camping purposes shall be exempt from the above requirements. Special permits required by 780 CMR shall be secured from the code official.

3104.2 Construction documents: A permit application and *construction documents* shall be submitted for each installation of a temporary structure. The *construction documents* shall include a site plan indicating the location of the temporary structure and information delineating the *means of egress* and the occupant load.

3104.3 Location: All temporary structures shall be located in accordance with the requirements of Table 705.2 based on the fireresistance rating of the exterior walls for the proposed type of construction.

3104.4 Construction: Tents and air-supported structures shall be constructed as required by this code and NFiPA 102 listed in ***Appendix A***.

3104.5 Membrane material: The *membrane* material for all tents shall be of approved noncombustible material as defined in 780 CMR 704.4; flameresistant material as determined in accordance with both the small-scale and large-scale tests in NfiPA 701 listed in ***Appendix A***; or material treated in an approved manner to render the material flameresistant.

3104.6 Certification: An affidavit or affirmation shall be submitted to the code official and a copy retained on the premises on which the tent or air-supported structure is located. The affidavit shall attest to the following information relative to the flameresistance of the fabric:

1. Names and addresses of the owners of the tent or air-supported structure.
2. Date the fabric was last treated with flame-resistant solution.
3. Trade name or kind of chemical used in treatment.
4. Name of person or firm treating the material.
5. Name of testing agency and test standard by which the fabric was tested.

3104.7 Inflation pressure: Operating pressure shall be maintained at the design pressure specified by the manufacturer to assure structural stability and to avoid excessive distortion during high *wind* or *snow loads*.

3104.8 Door operation: In high winds over 50 mph (80.45 km/h) or in snow conditions, the doors in air-supported structures shall be controlled to avoid excessive air loss. Doors shall not be left open under any conditions.

3104.9 Means of egress: All temporary structures including tents and *membrane* structures shall conform to the *means of egress* requirements of 780 CMR 10 and shall have a maximum *exit access* travel distance of 100 feet (30480 mm).

780 CMR 3105.0 CANOPIES AND AWNINGS

3105.1 General: Rigid canopies or awnings supported in whole or in part by members resting on the ground and used for patio covers, car ports, summer houses or other similar uses shall comply with the requirements of 780 CMR 3105.2 through 3105.4 for design and construction. Such structures shall be braced as required to provide rigidity.

3105.2 Design and construction: Fixed awnings, canopies and similar structures shall be designed and constructed to withstand *wind* or other *lateral loads* and *live loads* as required by 780 CMR 16 with due allowance or shape, open construction and similar features that relieve the pressures or *loads*. Structural members shall be protected to prevent deterioration.

3105.3 Canopy materials: Canopies shall be constructed of a metal framework with an approved covering, that is flameresistant as determined by both the small-scale and large-scale tests in accordance with NFiPA 701 listed in ***Appendix A*** or that has a flame spread rating not greater than 25 when tested in accordance with ASTM E84 listed in ***Appendix A***. Canopies shall be attached to the building at the inner end and supported at the outer end by not less than two stanchions, with braces anchored in an approved manner. The stanchions shall be placed not less than 44 inches (1118 mm) apart. The horizontal portion of the framework shall not be less than eight feet (2438 mm) nor more than 12 feet (3658 mm) above the walking surface and the clearance between the covering or valance and the walking surface shall not be less than seven feet (2134 mm).

3105.4 Projections: In addition to 780 CMR 3105.0, awnings and canopies that are constructed in the public right-of-way shall conform to the requirements of 780 CMR 32.

780 CMR 3106.0 PEDESTRIAN WALKWAYS

3106.1 General: An exterior elevated pedestrian walkway that connects buildings shall comply with 780 CMR 3106.0. The walkway shall not contribute to the *building area* or the number of stories or *height* of connected buildings.

3106.1.1 Separate structures: Connected buildings shall be considered to be separate structures.

Exception: Buildings on the same lot in accordance with 780 CMR 503.1.3.

3106.2 Construction: The walkway shall be of noncombustible construction.

Exception: Combustible construction shall be permitted where all connected buildings are of combustible construction.

3106.3 Occupancy: The walkway shall not be occupied for other than low fire-hazard uses and only approved materials and decorations shall be located in the space.

3106.4 Separation assemblies between walkways and buildings: Walkways shall be separated from the interior of the building by *fire separation walls* with a fireresistance rating of not less than two hours. This protection shall extend vertically from a point ten feet (3048 mm) above the walkway roof surface or the connected building roof line, whichever is lower, down to a point ten feet (3048 mm) below the walkway and horizontally ten feet (3048 mm) from each side of the walkway. Openings within the ten-foot (3048 mm) horizontal extension of the *protected* walls beyond the walkway shall be equipped with fixed ¾-hour opening protectives.

Exception: The walls separating the walkway from a connected building are not required to have a fireresistance rating by 780 CMR 3106.4, given compliance with one of the following:

1. Where the distance between the connected buildings is more than ten feet (3048 mm), the walkway and connected buildings are equipped throughout with an *automatic sprinkler system* in accordance with 780 CMR 906.2.1, and the wall is constructed of a tempered, wired or laminated glass wall and doors subject to the following:
    - 1.1. The glass shall be protected by an *automatic sprinkler system* in accordance with 780 CMR 906.2.1 and the *sprinkler* system shall completely wet the entire surface of interior sides of the glass wall when actuated.
    - 1.2. The glass shall be in a gasketed frame and installed in such a manner that the framing system will deflect without breaking (loading) the glass before the *sprinkler* operates.
    - 1.3. Obstructions shall not be installed between the *sprinkler* heads and the glass;
2. Where the distance between the connected buildings is more than ten feet (3048 mm), and both sides are at least 50% open with the open area uniformly distributed to prevent the accumulation of smoke and toxic gases;
3. Buildings on the same *lot*, in accordance with 780 CMR 503.1.3; or
4. Where exterior walls of connected buildings are required by 780 CMR 705.0 to have a fireresistance rating greater than two hours, the walkway shall be equipped throughout with an *automatic sprinkler system* installed in accordance with 780 CMR 9.

3106.5 Public way: The installation of a pedestrian walkway over a *public way* shall be subject to the approval of local authorities. Construction criteria for approved walkways shall meet the requirements of 780 CMR 3106.0.

3106.6 Egress: Access shall be provided at all times to a pedestrian walkway that serves as a required *exit*.

3106.7 Width: The unobstructed width of pedestrian walkways shall not be less than 36 inches (914 mm). The total width shall not exceed 30 feet (9144 mm).

3106.8 Exit access travel: The length of *exit access* travel shall not exceed 200 feet (60960 mm).

Exceptions:

1. *Exit access* travel distance on a walkway equipped throughout with an *automatic sprinkler*

system in accordance with 780 CMR 9 shall not exceed 250 feet (76200 mm) in length.

2. *Exit access* travel distance on a walkway constructed with both sides at least 50% open shall not exceed 300 feet (91440 mm) in length.

780 CMR 3107.0 FLOOD-RESISTANT CONSTRUCTION

3107.1 General: All buildings and structures erected in areas prone to flooding shall be constructed and elevated as required by the provisions of 780 CMR 3107.0.

3107.2 Definitions: The following words and terms shall, for the purposes of 780 CMR 3107, and as used elsewhers in 780 CMR, have the meanings shown herein:

A-Zones: Flood-hazard zones- all areas which have been determined to be prone to flooding, but not subject to high-velocity waters or wave action.

Base Flood Elevation: The flood having a 1% chance of being equalled or exceed in any given year and shall be used to define areas prone to flooding, and describe at a minimum, the depth or peak elevation of flooding.

Basement/cellar: Any area of the building having its floor subgrade (Below ground level) on all sides.

Breakaway Wall: A wall that is not part of the structural support of the building and intended, through its design and construction, to collapse under specific lateral loading forces, without causing damage to the elevated portion of the building or supporting foundation system.

Elevation: The placement of a structure above flood level to minimize or prevent flood damages.

Flood Hazard Zones: Areas which have been determined to be prone to flooding but not to high velocity waters or wave action. (A ZONES)

Floodproofing: Any combination of structural and non-structural additions, changes or adjustments to structures which reduce or eliminate flood damage to new or substantially improved structures.

F.E.M.A.: Federal Emergency Management Agency.

Flood Insurance Rate: Flood insurance rate map (FIRM) means an official map of a community, which delineates both the special hazard areas and the risk premium zones applcable to the community.

Flood Proofing: Any combination of structural and nonstructural additions, changes, or adjustments to structures which reduce or eliminate flood damage to non-residential structures.

High-hazard Zones (V Zones) Areas of tidal influence which have been determined to be subject to wave run heights in excess of three feet or subject to high-velocity wave run-up or wave-induced erosion (V Zones).

Highest Adjacent Grade: The highest natural elevation of the ground surface, prior to construction, adjoining the proposed foundation walls of a structure.

Impact Loads: Loads induced by the collision of solid objects on a structure carried by floodwater.

Lowest Floor: The lowest floor of the lowest enclosed area (including basement/cellar). An unfinished or flood resistant enclosure, usable solely for parking of vehicles, building access, or incidental storage in an area other than a basement/cellar with appropriate hydrostatic openings as required in 780 CMR 3107.5.3 is not considered a building's lowest floor.

Manufactured Home: See DEFINITIONS, 780 CMR 3502.

Scouring: The erosion or washing away of slopes or soil by velocity waters.

Special Hazard Zones: An area having special flood, and/or flood-related erosion hazards and shown on a Flood Hazard Boundry Map or FIRM as Zone A, AO, A1-30, AE, A99, AH, VO, V1-30, VE, V.

Start of Construction: The date the building permit was issued, provided the actual start of construction, repair, reconstruction, placement, or other improvement was within 180 days of the permit date. The actual start means the first placement of permanent construction of a structure on a site, such as the pouring of slab or footings, the installation of piles, the construction of columns, or any work beyond the stage of excavation or the placement of a manufactured home on a foundation.

Structure: A walled and roofed building, including a gas or liquid storage tank, that is principally above ground and affixed to a permanent site, as well as a manufactured home.

Substantial Improvements: *Substantial improvement means any reconstruction, rehabilitation, addition, repair or improvement of a structure, the cost of which equals or exceeds 50% of the market value of the structure before the "start of construction" of the improvement. This term includes structures which have incurred "Substantial damage", regardless of the actual repair work performed. Substantial improvement does not, however, include either:*

1. any project for improvement of a structure to correct existing violations of state or local health. sanitary, or safety codes which have been identified by the local code enforcement official and which are the minimum necessary to assure safe living conditions or

2. any alteration of a "Historic structure", provided that the alteration will not preclude the structure's continued designation as a "historic structure."

Note 1: The following items can be excluded from the cost of improvement or repair: plans, specifications, survey, permits, and other items which are separate from or incidental to the repair of the damaged or improved building. i.e. debris removal/cartage.

Note 2: The latest Assessors'structure value may be used, provided that the Assessors certify that said value is based on 100% valuation, less depreciation.

V Zones: Areas of tidal influence which have been determined to be subject to wave run heights in excess of three feet or subject to high-velocity wave run-up or wave-induced erosion. (V Zones)

Variance: A grant of relief by a community and the Commonwealth, via the Boards of Appeal, from the terms of the Floodplain Management Regulations.

Venting A system designed to allow flood waters to enter an enclosure, usually the interior of foundations walls, so that the rising water does not create a dangerous differential in hydrostatic pressure; usually achieved through openings in the walls. Vents may be installed in garage doors to satisfy this requirement, provided such vents are installed consistent with 780 CMR 3107. The necessity of human intervention, such as opening garage doors, does not satisfy this requirement.

3107.3 Base flood elevation: The base flood elevation shall be used to define areas prone to flooding, and shall describe, at a minimum, the depth or peak elevation of flooding (including wave height) which has a 1% (100-year flood) or greater chance of occurring in any given year.

The 100-year flood elevation shall be determined as follows:

1. In A1-30, AH, AE, V1-30 and VE, the Base Flood Elevation is provided on the community's Flood Insurance Study and the Flood Insurance Rate Map (FIRM).

2. In AO zones, add the depth provided on the Flood Insurance Rate Map to the highest adjacent grade. If no depth is provided, add at least two feet to the highest adjacent grade.

3. In A, A99 and V zones, the building official, design professional, or surveyor shall obtain, review and reasonably utilize and Base Flood Elevation Data available from a federal, state or other reliable sources.

3107.4 Hazard zones: Areas which have been determined to be prone to flooding shall be classified as either flood-hazard zones (A Zones) or high-hazard zones (V Zones) in accordance with 780 CMR 3107.5 and 3107.6.

3107.5 Flood-hazard zones (A Zones): All areas which have been determined to be prone to flooding but not subject to high-velocity waters or wave action shall be designated as floodhazard zones. All buildings and structures as defined in 780 CMR 3107.2 erected *or substantially improved* in floodhazard zones shall be designed and constructed in accordance with 780 CMR 3107.5.1 through 3107.5.4. *Plans for such construction or improvements shall be prepared by a qualified registered professional engineer or architect to ensure the compliance with 780 CMR 3107.5.*

Exception: a proposed addition that triggers the substantial improvement requirements shall be constructed according to the provisions of 780 CMR 3107.5. However, the existing structure is not required to be brought into compliance with 780 CMR 3107.5, provided that the addition IS NOT an additional story(s) which relies on the support of the existing structure.

Should the construction of an additional story(s) meet the substantial improvement definition, the existing structure shall then meet all the applicable provisions of 780 CMR 3107.5.

3107.5.1 Elevation: All buildings or structures erected within a flood-hazard zone shall be elevated so that the lowest floor is located at or above the base flood elevation. All *basement/ cellar* floor surfaces shall be located at or above the base flood elevations.

Exceptions:

1. Floors of occupancy in any use group, other than use group R, below the base flood elevation shall conform to 780 CMR 3107.5.4.

2. Floors of occupancies in any use group which are utilized solely for structure means of egress, incidental storage garages and parking, and which are located below the base

flood elevation, shall conform to 780 CMR 3107.5.3.

3107.5.2 Anchorage: The structural systems of all buildings or structures shall be designed, connected and anchored to resist flotation, collapse or permanent lateral movement due to structural *loads* and stresses from flooding equal to the base flood elevation and shall be designed in accordance with 780 CMR 1615.3 and 1615.4.

3107.5.3 Enclosures below base flood elevation: Enclosed spaces below the base flood elevation shall not be used for human occupancy with the exception of structure *means of egress*, entrance foyers, *stairways* and incidental storage. Fully enclosed spaces shall be designed to equalize automatically hydrostatic forces on exterior walls by allowing for the entry and exit of floodwaters. Designs for meeting this requirement shall either be certified by a *registered design professional* in accordance with 780 CMR 3107.12 or conform to the following minimum criterion: a minimum of two openings having a total net area of not less than one square inch (645 mm^2) for every one square foot (0.1 m^2) of enclosed area subject to flooding shall be provided. The bottom of all openings shall not be higher than 12 inches (305 mm) above grade immediately adjacent to the location of the opening. Openings shall not be equipped with screens, louvers, valves or other coverings or devices unless such devices permit the automatic entry and discharge of floodwaters.

3107.5.4 Water-resistant construction: Occupancies in any use group other than Use Group R shall, in lieu of meeting the elevation provisions of 780 CMR 3107.5.1, be erected with floors usable for human occupancy below the base flood elevation provided that the following conditions are met:

1. All space below the base flood elevation shall be constructed with walls and floors that are substantially impermeable to the passage of water.
2. All structural components subject to hydrostatic and hydrodynamic *loads* and stresses during the occurrence of flooding to the base flood elevation shall be capable of resisting such forces, including the effects of buoyancy.
3. All openings below the base flood elevation shall be provided with water-tight closures and shall have adequate structural capacity to support all flood *loads* acting upon the closure surfaces
4. All floor and wall penetrations for plumbing, mechanical and electrical systems shall be made water tight to prevent floodwater seepage through spaces between the penetration and wall construction materials. Sanitary sewer and storm drainage systems that have openings below the base flood elevation shall be provided with shutoff valves or closure devices to prevent backwater flow during conditions of flooding.

3107.6 High-hazard zones (V Zones): Areas of tidal influence which have been determined to be subject to wave heights in excess of three feet (914 mm) or subject to high-velocity wave run-up or wave-induced erosion shall be classified as high-hazard zones. All buildings or structures erected in a high-hazard zone shall be designed and constructed in accordance with 780 CMR 3107.6.1 through 3107.6.4. ***Plans for such construction shall be prepared by a registered professional engineer or architect to ensure compliance with 780 CMR 3107.6***

Exception: a proposed addition that triggers the substantial improvement requirements shall be constructed according to the provisions of 780 CMR 3107.6. However, the existing structure is not required to be brought into compliance with 780 CMR 3107.6, provided that the addition IS NOT an additional story(s) which relies on the support of the existing structure.

Should the construction of an additional story(s) meet the substantial improvement definition, the existing structure shall then meet all the applicable provisions of 780 CMR 3107.6.

Note: Areas shown as V Zones on the most recent Flood Insurance Rate Map published by the Federal Emergency Management Agency shall be considered in establishing high-hazard zones.

3107.6.1 Elevation: All buildings or structures erected within a high-hazard zone shall be elevated so that the lowest portion of all structural members supporting the lowest floor, with the exception of mat or raft foundations, piling, pile caps, columns, grade beams and bracing, is located at or above the base flood elevation.

3107.6.2 Enclosures below base flood elevation: All spaces below the base flood elevation in a high-hazard zone shall not be used for human occupancy and shall be free of obstruction except as permitted herein:

1. Mat or raft foundations, piling, pile caps, bracing, grade beams and columns which provide structural support for the building.
2. Entrances and *exits* which are necessary for required ingress and *means of egress*.
3. Incidental storage of portable or mobile items readily moved in the event of a storm.
4. Walls and partitions are permitted to enclose all or part of the space below the elevated floor provided that such walls and partitions are not part of the structural support of the building and are constructed with insect screening, open wood lattice, or nonsupporting walls designed to break away or collapse without causing collapse, displacement or other

structural damage to the elevated portion of the building or supporting foundation system due to the effect of *wind loads* as specified in 780 CMR 1611.0 and water *loads* as specified in 780 CMR 1615.0 acting simultaneously. Any such nonsupporting solid wall shall be certified as specified in 780 CMR 3107.12.3.

3107.6.3 Foundations: All buildings or structures erected in high-hazard zones shall be supported on pilings or columns and shall be adequately anchored to such pilings or columns. The piling shall have adequate soil penetrations to resist the combined wave and *wind loads* (lateral and uplift) to which such piles are likely to be subjected during a flood to the base flood elevation. Pile embedment shall include consideration of decreased resistance capacity caused by scour of soil strata surrounding the piling. Pile system design and installation shall also be made in accordance with the provisions of 780 CMR 1816.0 and 1817.0. Mat or raft foundations which support columns shall not be permitted where soil investigations required in accordance with 780 CMR 1802.1 indicate that soil material under the mat or raft is subject to scour or erosion from wave-velocity flow conditions.

3107.6.4 Repair or Replacement of Existing Foundations: Existing foundations may be repaired without further compliance with 780 CMR 3107 unless the work required is determined to be substantial as defined herein.

Exception: Existing foundation systems which are replaced in total or which are replaced so as to constitute new construction shall meet the requirements of 780 CMR 3107.6 regardless of whether the work required is substantial.

3107.7 Protection of mechanical and electrical systems: New and replacement electrical equipment and heating, *ventilating*, air conditioning and other service equipment shall be either placed above the base flood elevation or protected so as to prevent water from entering or accumulating within the system components during floods up to the base flood elevation in accordance with the mechanical code listed in ***Appendix A***. Installation of electrical wiring and outlets, switches, junction boxes and panels below the base flood elevation shall conform to the provisions of 527 CMR 12.00 listed in ***Appendix A*** for location of such items in wet locations. Duct insulation subject to water damage shall not be installed below the base flood elevation.

3107.8 Construction materials, methods and practices: All buildings or structures erected in flood-hazard zones (A Zones) or in high-hazard zones (V Zones) shall be constructed with materials resistant to flood damage and be constructed by methods and practices that minimize flood damage. Construction materials shall be resistant to water damage in accordance with the provisions of 780 CMR 1808.0, 1810.2,1813.4, 2307.2, 2309.1, 2311.4, 2311.6 and 2503.4.

3107.9 Mobile units: New or replacement *mobile units* to be located in any hazard zone shall be placed in accordance with the applicable elevation requirements of 780 CMR 3107.5.1 and 3107.6.1 and the anchor and tie-down requirements of 780 CMR 35.

3107.10 Alterations, renovations and repairs: Alterations, renovations and repairs to existing buildings located in any hazard zone shall comply with all applicable provisions of 780 CMR. Compliance with 780 CMR 3107 is not required unless such alteration, renovation or repairs constitute substantial improvements as defined in 780 CMR 3107.2.

Exception: Repair or replacement of existting foundations shall comply with 780 CMR 3107.6.4.

3107.11 Increases in building height and floor area: *See 780 CMR 3107.5 Exception and 3107.6 Exception*.

3107.12 Certifications: Certifications shall be submitted in accordance with 780 CMR 3107.12.1 through 3107.12.3.

3107.12.1 As-built elevation certifications: A licensed land surveyor or *registered design professional* shall certify the actual elevation (in relation to base flood elevation) of the lowest structural member required to be elevated by the provisions of 780 CMR 12.

3107.12.2 Waterresistant construction: Where buildings or structures are to be constructed in accordance with 780 CMR 3107.5.4, the code official shall require that a *registered design professional* provide *construction documents* showing proposed details of floor, wall and foundation support components, loading computations and other essential technical data used in meeting the conditions of 780 CMR 3107.5.4. The *construction documents* shall be accompanied by a statement bearing the signature of the *registered design professional* indicating that the design and proposed methods of construction are in accordance with all applicable provisions of 780 CMR 3107.5.4.

3107.12.3 High-hazard construction: Where buildings or structures are to be constructed in accordance with 780 CMR 3107.6, the code official shall require that a *registered design professional* provide *construction documents* showing proposed details of foundation support and connection components which are used in meeting the requirements of 780 CMR 3107.6.3. Where solid walls or partitions are proposed below the base flood elevations, wall, framing and connection details of such walls shall be provided, including *loading* computations for the wall and foundation system used in meeting the conditions of 780 CMR 3107.6.2. The *construction documents* shall be accompanied by a statement bearing the signature of the *registered design professional* indicating that the design and proposed methods of construction are in accordance with all applicable provisions of 780 CMR 3107.6.

780 CMR 3108.0 RADIO AND TELEVISION TOWERS

3108.1 General: Subject to the structural provisions of 780 CMR 1611.0 for *wind loads* and the requirements of 780 CMR 1510.0 governing the fireresistance ratings of buildings for the support of roof structures, all radio and television towers shall be designed and constructed as herein provided.

3108.2 Location and access: Towers shall be located and equipped with step bolts and ladders so as to provide ready access for inspection purposes. Guy wires or other accessories shall not cross or encroach upon any street or other public space, or over any electric power lines, or encroach upon any other privately owned property without *written* consent of the owner.

3108.3 Construction: All towers shall be constructed of approved corrosion-resistant noncombustible material. The minimum type of construction of isolated radio towers not more than 100 feet (30480 mm) in height shall be Type 4.

3108.4 Loads: Towers shall be designed to resist *wind loads* in accordance with EIA 222-E listed in *Appendix A.* Consideration shall be given to conditions involving *wind load* on ice-covered sections in localities subject to sustained freezing temperatures.

3108.4.1 Dead load: Towers shall be designed for the *dead load* plus the ice *load* in regions where ice formation occurs.

3108.4.2 Uplift: Adequate foundations and anchorage shall be provided to resist two times the calculated wind uplift.

3108.5 Grounding: All towers shall be permanently and effectively grounded.

780 CMR 3109.0 RADIO AND TELEVISION ANTENNAS

3109.1 Permits not required: A building permit is not required for roof installation of antennal structures not more than 12 feet (3658 mm) in height for private radio or television reception. Such a structure shall not be erected so as to injure the roof covering, and when removed from the roof, the roof covering shall be repaired to maintain weather and water tightness. The installation of any antennal structure mounted on the roof of a building shall not be erected nearer to the *lot line* than the total height of the antennal structure above the roof, nor shall such structure be erected near electric power lines or encroach upon any street or other public space.

3109.2 Permits required: Approval shall be secured for all roof-mounted antennal structures more than 12 feet (3658 mm) in height above the roof. The application shall be accompanied by detailed drawings of the structure and methods of anchorage. All connections to the roof structure shall be properly flashed to maintain water tightness. The design and materials of construction shall comply with the requirements of 780 CMR 3108.3 for character, quality and minimum dimension.

3109.3 Dish antennas: An antenna consisting of a radiation element which transmits or receives radiation signals generated as electrical, light or sound energy, and supported by a structure with or without a reflective component to the radiating dish, usually in a circular shape with a parabolic curve design constructed of a solid or open mesh surface, shall be known as a dish antenna.

3109.3.1 Permits: The approval of the code official shall be secured for all dish antennal structures more than two feet (610 mm) in diameter erected on the roof of or attached to any building or structure. A permit is not required for dish antennas not more than two feet (610 mm) in diameter erected and maintained on the roof of any building.

3109.3.2 Structural provisions: Dish antennas larger than two feet (610 mm) in diameter shall be subject to the structural provisions of 780 CMR 1610.0,1611.0 and 3108.4. The snow *load* provisions of 780 CMR 1610.0 shall not apply where the antenna has a heater to melt falling snow.

780 CMR 3110.0 WINDOW-CLEANING SAFEGUARDS

3110.1 General: All buildings and structures over 50 feet (15240 mm) or four stories in *height*, in which the windows are cleaned from the outside, shall be provided with anchors, belt terminals or other approved safety devices for all window openings. Such devices shall be of an approved design, and shall be constructed of corrosion-resistant materials securely attached to the window frames or anchored in the enclosure walls of the building. Cast-iron or cast-bronze anchors shall be prohibited.

CHAPTER 32

CONSTRUCTION IN THE PUBLIC RIGHT-OF-WAY

780 CMR 3201.0 GENERAL

3201.1 Scope: The provisions of 780 CMR 32 shall govern encroachment and projection of structures into the public right-of-way.

780 CMR 3202.0 STREET ENCROACHMENTS

3202.1 General: Except as herein provided, a part of any building hereafter erected and *additions* to an existing building heretofore erected shall not project beyond the *lot lines* or beyond the building line where such lines are established by the *zoning* law or any other statute controlling building construction.

3202.2 Below grade: A part of a building hereafter erected below grade that is necessary for structural support of the building shall not project beyond the *lot lines,* except that the footings of street walls or their supports which are located at least eight feet (2438 mm) below grade shall not project more than 12 inches (305 mm) beyond the *street lot line*.

3202.3 Above grade: All projections hereafter permitted beyond the *street lot line* or the building line above grade shall be so constructed as to be readily removable without endangering the safety of the building.

3202.4 Projections necessary for safety: In any specific application, the code official is authorized to designate by *approved rules* such architectural features and accessories which are deemed desirable or necessary for the health or safety of the public as well as the maximum extent to which such features shall project beyond the *street lot line* or the building line where established by statute, subject to all provisions and restrictions that are otherwise prescribed by law, ordinance or rule of the authorities having jurisdiction over streets or public spaces.

3202.5 Permit revocable: Any permit granted or permission expressed or implied in the provisions of this code to construct a building so as to project beyond the *street lot line* or building line shall be revocable by the jurisdiction at will.

3202.6 Existing encroachments: Parts of existing buildings and structures which already project beyond the *street lot line* or building line are not required to be altered until their removal is directed by the proper authorities of the jurisdiction.

780 CMR 3203.0 PERMISSIBLE STREET PROJECTIONS

3203.1 General: Subject to such provisions as are otherwise prescribed by law or ordinance, or by rules of the authorities having jurisdiction over streets, highways and public spaces, the projections described in 780 CMR 3203.3 through 3203.12.1 shall be permitted beyond the *street lot line* or the building line.

3203.2 Definitions: The following words and terms shall, for the purposes of 780 CMR 3203.0 and as used elsewhere in 780 CMR, have the meanings shown herein.

Areaway (form of construction): An uncovered subsurface space adjacent to a building (see 780 CMR 3203.12.1).

Curb level: The elevation of the street curb as established in accordance with law.
Building or wall height: The elevation of the street grade opposite the center of the wall nearest to and facing the *street lot line*.

Oriel window: A window projected beyond and suspended from the wall of the building or cantilevered therefrom (see 780 CMR 3203.7).

3203.3 Cornices and eaves: Main cornices or roof eaves located at least 12 feet (3658 mm) above the curb level shall not project more than three feet (914 mm).

3203.4 Architectural decorations: Belt courses, lintels, sills, architraves, pediments and similar architectural decorations shall not project more than four inches (102 mm) where less than ten feet (3048 mm) above the curb level, and not more than ten inches (254 mm) where ten feet (3048 mm) or more above the curb level.

3203.5 Ornamental columns: Ornamental columns or pilasters, including the bases and moldings which emphasize the main entrance of the building, shall not project more than 12 inches (305 mm).

3203.6 Entrance steps: Entrance steps and doors shall not project more than 12 inches (305 mm) and shall be guarded by check pieces not less than three feet (914 mm) high, or shall be located between ornamental columns or pilasters

3203.7 Oriel windows: *Oriel windows* with the lowest portion at least ten feet (3048 mm) above the curb level shall not project more than 2½ feet (762 mm).

3203.8 Balconies: Balconies located at least ten feet (3048 mm) above the curb level shall not project more than three feet (914 mm), except that where the balcony is required in connection with a fire escape or exterior *stairway* as an element of a *means of egress*, the projection shall not exceed four feet (1219 mm).

3203.9 Awnings: Retractable or fixed awnings shall have clearances above grade and shall be installed in accordance with the requirements of 780 CMR 3105.0 and 3205.0.

3203.10 Awning covers or boxes: Awning covers or boxes located at least eight feet (2438 mm) above the curb level shall not project more than three feet (914 mm).

3203.11 Marquees: For the purposes of 780 CMR 3203.11, a marquee shall include any object or decoration attached to, or part of, said marquee.

3203.11.1 Projection and clearance: The horizontal clearance between a marquee and the curb line shall not be less than two feet (610 mm). A marquee projecting more than ⅔ of the distance from the property line to the curb line shall not be less than ten feet (3048 mm) above the ground or pavement below.

3203.11.2 Thickness: The maximum height or thickness of a marquee measured vertically from its lowest to its highest point shall not exceed three feet (914 mm) where the marquee projects more than ⅔ of the distance from the property line to the curb line, and shall not exceed nine feet (2743 mm) where the marquee is less than ⅔ of the distance from the property line to the curb line.

3203.11.3 Roof construction: Where the roof or any part thereof is a skylight, the materials shall consist of approved *plastics* or wired glass not less than ¼ inch thick with a single pane not more than 18 inches (457 mm) wide. Every roof and skylight of a marquee shall be sloped to downspouts that shall conduct any drainage from the marquee in such a manner so as not to spill over the sidewalk.

3203.11.4 Location prohibited: Every marquee shall be so located as not to interfere with the operation of any exterior *standpipe*, and such that the marquee does not obstruct the clear passage of *stairway* or *exit discharge* from the building or the installation or maintenance of street lighting.

3203.11.5 Construction: A marquee shall be supported entirely from the building and constructed of noncombustible materials. Marquees shall be designed and constructed to withstand *wind* or other *lateral loads* and *live loads* as required in 780 CMR 16. Structural members shall be protected to prevent deterioration.

3203.12 Vaults: Vaults below the sidewalk level shall not extend closer than three feet (914 mm) to the curb line. The construction and utilization of such vaults shall be subject to the terms and conditions of the authority or legislative body having jurisdiction.

3203.12.1 Areaways: *Areaways* shall not project beyond the *street lot line* more than four feet (1219 mm), provided that every such *areaway* shall be covered over at the street grade by an approved grating of metal or other noncombustible material.

780 CMR 3204.0 SPECIAL AND TEMPORARY PROJECTIONS

3204.1 Alley projections: The permissible projection beyond *street lot lines* shall apply in general to building projections into alleyways, except as modified by the authority having jurisdiction or by special deed restriction.

3204.2 Special permits: Where authorized by special permit, vestibules and storm doors shall be erected for periods of time not exceeding seven months in any one year, and shall not project more than three feet (914 mm) nor more than ¼ of the width of the sidewalk beyond the *street lot line*. Temporary entrance awnings shall be erected with a minimum clearance of seven feet (2134 mm) to the lowest portion of the hood or awning where supported on removable steel, or other approved noncombustible supports.

780 CMR 3205.0 AWNINGS AND CANOPIES

3205.1 Permit: A permit shall be obtained from the code official for the erection, repair or replacement of any fixed awning, canopy or hood, except as provided for in 780 CMR 3205.1.1, and for any retractable awning located at the first-story level and extending over the public street or over any portion of a *court* or yard beside a building serving as a passage from a required *exit* or *exit discharge* to a public street.

3205.1.1 Exemption from permit: A permit shall not be required: for the erection, repair or replacement of fixed or retractable awnings installed on occupancies in Use Group R-3 unless such awnings project over public property; for retractable awnings installed above the first story; or where the awning does not project over the public street or over any court or yard serving as a passage from a required *exit* to a public street.

3205.2 Retractable awnings: There shall be a minimum clearance of seven feet (2134 mm) from the sidewalk to the lowest part of the framework or any fixed portion of any retractable awning, except that the bottom of the valance of canvas awnings shall have a minimum clearance of six feet nine inches (2057 mm) above the sidewalk. Retractable awnings shall be securely fastened to the building and shall not extend closer than 12 inches (305 mm) in from the curb line. Retractable awnings shall be equipped with a mechanism or device for raising and holding the awning in a retracted or closed position against the face of the building.

3205.3 Fixed or permanent awnings: The clearance from the sidewalk to the lowest part of any fixed or permanent awning shall be the same as required in 780 CMR 3205.2 for retractable awnings. Fixed or permanent awnings installed above the first story shall not project more than four feet (1219 mm).

3205.4 Canopies: Stanchions that support canopies shall be placed not less than two feet (610 mm) in from the curb line. The horizontal portion of the canopy framework shall not be less than eight feet (2438 mm) nor more than 12 feet (3658 mm) above the sidewalk and the clearance between the covering or valance and the sidewalk shall not be less than seven feet (2134 mm).

NON-TEXT PAGE

CHAPTER 33

SITE WORK, DEMOLITION AND CONSTRUCTION

780 CMR 3301.0 GENERAL

3301.1 Scope: The provisions of 780 CMR 33 shall apply to all construction in connection with work requiring a permit for structures in accordance with 780 CMR.

3301.2 Other laws: Nothing herein contained shall be construed to nullify any rules, regulations or statutes of state or federal agencies governing the protection of the public or workers from health or other hazards.

When not covered by the provisions of 780 CMR, 454 CMR 10.00: Construction Industry Rules and Regulations, shall apply.

3301.3 Combustible and explosive hazards: The provisions of 780 CMR which apply to the storage, use or transportation of *explosives*, highly *flammable* and combustible substances, gases and chemicals shall be construed as supplemental to the requirements of the federal laws, the regulations of the Department of Transportation (DOTn) and ***527 CMR 13.00, Keeping, Storage, Use, Manufacture, Sale, Handling, and Transportation of Explosives, as listed in Appendix A.***

780 CMR 3302.0 CONSTRUCTION DOCUMENTS AND SPECIAL PERMITS

3302.1 Temporary construction: Before any construction operation is started, *construction documents* shall be filed with the code official showing the design and construction of all sidewalk sheds, temporary vehicular passageways, trestles, foot bridges, guard fences and other similar devices required in the operation. Approval shall be secured from the ***code official*** before the commencement of any work.

3302.2 Special permits: All special licenses and permits for the storage of materials on sidewalks and highways, for the use of water or other public facilities and for the storage and handling of *explosives*, shall be secured from the administrative authorities having jurisdiction.

3302.3 Temporary encroachments: Sidewalk sheds, underpinning and other temporary protective guards and devices shall not project beyond the *interior* and *street lot lines* except where required to insure the safety of the adjoining property and the public, subject to approval. Where necessary, the consent of the adjoining property owner shall be obtained.

780 CMR 3303.0 TESTS

3303.1 Loading: It shall be unlawful to *load* any structure, temporary support, sidewalk bridge or sidewalk shed or any other device during the construction or demolition of any building or structure in excess of its safe working capacity as provided for in 780 CMR 16 for allowable *loads* and working stresses.

780 CMR 3304.0 PROTECTION OF PUBLIC

3304.1 General: Wherever a building or structure is erected, *altered*, repaired, removed or demolished, the operation shall be conducted in a safe manner and suitable protection for the general public shall be provided.

3304.2 Fences: Every excavation or area of construction on a site located five feet (1524 mm) or less from the *street lot line* shall be enclosed with a barrier not less than six feet (1829 mm) high to prevent the entry of unauthorized persons. Where located more than five feet (1524 mm) from the *street lot line*, a barrier shall be erected where required by the code official. All barriers shall be of adequate strength to resist wind pressure as specified in 780 CMR 1611.0.

3304.3 Sidewalk bridge: Wherever the ground is excavated under the sidewalk, a sidewalk bridge shall be constructed at least four feet (1219 mm) wide, or a protected walkway of equal width shall be erected in the street, provided that the required permit for such walkway is obtained from the administrative authority.

3304.4 Sidewalk shed: Sidewalk sheds shall be as provided for in accordance with 780 CMR 3304.4.1 through 3304.4.4 except where sidewalks are closed by the authority having jurisdiction.

3304.4.1 Within ten feet of street lot line: Where any building or part thereof which is located within ten feet (3048 mm) of the *street lot line* is to be erected or raised to exceed 40 feet (12192 mm) in *height*, or wherever a building which is more than 40 feet (12192 mm) in *height* and is within ten feet (3048 mm) of the *street lot line* is to be demolished, a sidewalk shed shall be erected and maintained for the full length of the building on all street fronts for the entire time that work is performed on the exterior of the building.

3304.4.2 Within 20 feet of street lot line: Where the building being demolished or erected is located within 20 feet (6096 m) of the *street lot* *line* and is more than 40 feet (12192 mm) in *height*, exterior flare fans or catch platforms shall be erected at vertical intervals of not more than two stories.

3304.4.3 Buildings higher than six stories: Where the building being demolished or erected is more than six stories or 75 feet (22860 mm) in *height*, unless set back from the *street lot line* a distance of more than ½ of the height of the building, a sidewalk shed shall be provided.

3304.4.4 Walkway: An adequately lighted walkway at least four feet (1219 mm) wide and eight feet (2438 mm) high in the clear shall be maintained under all sidewalk sheds for pedestrians. Where ramps are required, the ramps shall conform to the provisions of 780 CMR 33 and 780 CMR 1016.0.

3304.5 Thrust-out platforms: Thrust-out platforms or other substitute protection in lieu of sidewalk sheds shall not be used unless approved and deemed adequate to insure the public safety. Thrust-out platforms shall not be used for the storage of materials.

3304.6 Watchman: Wherever a building is being demolished, erected or *altered*, a watchman shall be employed to warn the general public when intermittent hazardous operations are conducted across the sidewalk or walkway.

780 CMR 3305.0 FIRE HAZARDS

3305.1 General: The provisions of 780 CMR and of the ***527 CMR: the Massachusetts State Board of Fire Prevention Regulations,*** listed in ***Appendix A*** shall be strictly observed to safeguard against all fire hazards attendant upon construction operations.

3305.2 Portable fire extinguishers: All buildings under construction, *alteration* or demolition shall be provided with at least one portable fire extinguisher with a minimum 2-A:20-B:C rating at each *exit* on all floor levels where combustible materials have accumulated. A portable fire extinguisher with a minimum 2-A:20-B:C rating shall also be provided in every storage and construction shed. Additionally, at least one portable fire extinguisher shall be provided in accordance with the ***527 CMR: the Massachusetts State Board of Fire Prevention Regulations,*** listed in ***Appendix A*** where special hazards, such as *flammable* or *combustible liquid* storage, exist.

3305.2.1 Steam boilers: All temporary or permanent high-pressure steam boilers shall be operated, or be in charge of an individual in possession of a current engineers or firemans license in accordance with the provisions of M.G.L. c. 146 and 522 CMR the Board of Boiler Rules as listed in Appendix A. When such boilers are located within a building or within ten feet thereof, all such boilers shall be enclosed with approved noncombustible construction.

3305.3 Standpipes: *Standpipes* required in buildings by 780 CMR 914.0 shall be installed when the work of the building progresses more than 40 feet (12192 mm) above the lowest level of fire department vehicle access. The *standpipes* shall be either temporary or permanent in nature, and with or without a *water supply*, provided that such *standpipes* conform to the requirements of 780 CMR 914.0 as to number of risers, capacity, outlets and materials. Access from the street to such *standpipes* shall be maintained at all times.

3305.3.1 Height: The *standpipe system* shall be carried up with each floor and shall be installed and ready for use as each floor progresses. *Standpipes* shall be extended as construction progresses to within one floor of the highest point of construction having secured decking or flooring.

3305.3.2 Outlets: Hose outlets shall be provided with caps and attachment chains.

3305.3.3 Fire department connections: For each temporary or permanent *standpipe* installation, there shall be provided, at the street level, one or more two-way fire department inlet connections. Access shall be provided to fire department inlet connections at all times, and such connections shall be prominently marked (see 780 CMR 915.8).

3305.3.4 Buildings under demolition: Where a building is being demolished and a *standpipe* is existing within such a building, such *standpipe* shall be maintained in an operable condition so as to be available for use by the fire department. Such *standpipe* shall be demolished with the building but shall not be demolished more than one floor below the floor being demolished.

780 CMR 3306.0 MAINTENANCE

3306.1 General: It shall be unlawful to remove or render inoperative any structural, fire protection or sanitary safeguard or device herein required except where necessary for the actual installation and prosecution of the work.

780 CMR 3307.0 HEALTH HAZARDS

3307.1 General: Every construction or maintenance operation which results in the diffusion of dust, stone and other small particles, toxic gases or other harmful substances in quantities hazardous to health shall be safeguarded by means of local *ventilation* or other protective devices to insure the safety of the public as required by the regulations of the administrative authority.

3307.2 Removal of dust: Dust, sand blasts or other harmful agents which are used or which occur in construction operations shall be disposed of at or near the point of origin to prevent diffusion over adjoining premises or streets.

3307.3 Protective equipment: Facilities shall be provided in approved closed containers for housing the necessary vision, respiratory and protective equipment required in welding operations, and in accordance with the regulations of the administrative authority.

780 CMR 3308.0 PROTECTION OF ADJOINING PROPERTY

3308.1 General: Adjoining property shall be completely protected from any damage caused by the construction of a structure when the owner of the adjoining property permits free access to the structure at all reasonable times to provide the necessary safeguards in accordance with 780 CMR 3310.0.

780 CMR 3309.0 EXISTING BUILDINGS

3309.1 Protection: All adjoining public and private property shall be protected from damage caused by construction.

3309.2 Chimney, soil and vent stacks: Wherever a new building or structure is erected to greater or lesser *heights* than an adjoining building, the construction and extension of new or existing chimneys shall conform to the provisions of the mechanical code listed in ***Appendix A***, and the construction and extension of soil and vent stacks and the location of window openings shall comply with the provisions of ***248 CMR***.

3309.3 Adjoining walls: The owner of the new or *altered* structure shall preserve all adjoining independent and party walls from damage as provided for herein. The owner shall underpin where necessary and support the adjoining building or structure by proper foundations to comply with 780 CMR 3310.0.

3309.3.1 Maintenance: In case an existing party wall is intended to be used by the person who causes an excavation to be made, and such party wall is in good condition and sufficient for the use of both the existing and proposed building, such person shall preserve the party wall from injury and shall support the party wall by proper foundations at said person's own expense, so that the wall is and remains as safe and useful as the party wall was before the excavation was commenced. During the demolition, the party wall shall be maintained weatherproof and structurally safe by adequate bracing until such time as the permanent structural supports have been provided.

3309.3.2 Beam holes: Where a structure involving a party wall is being demolished, the owner of the demolished structure shall, at his or her own expense, bend over all wall anchors at the beam ends of the standing wall and shall brick up all open beam holes and otherwise maintain the safety and usefulness of the wall.

3309.3.3 Party wall exits: A party wall balcony or *horizontal exit* shall not be destroyed unless and until a substitute *means of egress* has been provided and approved.

3309.4 Adjoining roofs: Where a new building or demolition of an existing building is being conducted at a greater *height*, the roof, roof outlets and roof structures of adjoining buildings shall be protected against damage with adequate safeguards by the person doing the work.

780 CMR 3310.0 DEMOLITION AND EXCAVATION

3310.1 Notice of intent: The person intending to cause a demolition or an excavation shall deliver *written* notice of such intent to the owner of each potentially affected adjoining *lot*, building or structure at least one week prior to the commencement of work. The notice shall request license to enter the potentially affected *lot*, building or structure prior to the commencement of work and at reasonable intervals during the work to inspect and preserve the *lot*, building or structure from damage.

3310.2 Protection of adjoining property: If afforded the necessary license to enter the adjoining *lot*, building or structure, the person causing the demolition or excavation to be made shall at all times and at his or her own expense preserve and protect the *lot*, building or structure from damage or injury. If the necessary license is not afforded, it shall be the duty of the owner of the adjoining *lot*, building or structure to make safe his or her own property, for the prosecution of which said owner shall be granted the necessary license to enter the premises of the demolition or excavation.

3310.2.1 Removal of debris: All waste materials shall be removed in a manner which prevents injury or damage to persons, adjoining properties and public rights-of-way.

3310.3 Notice to the code official: If the person causing a demolition or excavation to be made is not afforded license to enter an adjoining structure, that person shall immediately notify in *writing* both the code official and the owner of the adjoining property that the responsibility of providing support to the adjoining *lot* building or structure has become the exclusive responsibility of the owner of the adjoining property.

3310.4 Grading of lot: Where a structure has been demolished or removed and a building permit has not been approved, the vacant *lot* shall be filled, graded and maintained in conformity to the established elevation of the street grade at curb level nearest to the point of demolition or excavation. Provision shall be made to prevent the accumulation of water or damage to any foundations on the premises or the adjoining property.

3310.5 Utility connections: All service utility connections shall be discontinued and capped in accordance with the *approved rules* and the requirements of the authority having jurisdiction.

780 CMR 3311.0 RETAINING WALLS AND PARTITION FENCES

3311.1 General: Where the adjoining grade is not higher than the legal level, the person causing an excavation to be made shall erect, where necessary, a retaining wall at his or her own expense and on his or her own land. Such wall shall be built to a height sufficient to retain the adjoining earth, shall be properly coped as required in 780 CMR 1825.0 and shall be provided with a guardrail or fence not less than 42 inches (1067 mm) in height.

780 CMR 3312.0 STORAGE OF MATERIALS AND CONSTRUCTION EQUIPMENT

3312.1 General: The term "construction equipment" shall mean the machinery, tools, derricks, hoists, scaffolds, platforms, runways, ladders and all material-handling equipment, safeguards and protective devices used in construction operations. The term "runway" shall mean an aisle or walkway constructed or maintained as a temporary passageway for pedestrians or vehicles. All construction materials and equipment required for the permitted construction shall be stored and placed so as not to endanger the public, the workers or adjoining property.

3312.2 Design capacity: Construction materials and equipment stored within the building, or on sidewalks or sheds, shall be placed so as not to overload any part of the construction beyond the design capacity, nor interfere with the safe prosecution of the work.

3312.3 Pedestrian walkways: Construction materials and equipment shall not be stored on the street without a permit issued by the administrative authority having jurisdiction. Where so stored, such materials or equipment shall not unduly interfere with vehicular traffic or the orderly travel of pedestrians on the highway or street. The piles shall be arranged to maintain a safe walkway not less than four feet (1219 mm) wide, unobstructed for its full length, and adequately lighted at night and at all necessary times for the use of the Public.

3312.4 Obstructions: Construction materials and equipment shall not be placed or stored so as to obstruct access to fire hydrants, *standpipes*, fire or police alarm boxes, utility boxes, catch basins or manholes, nor shall such material and equipment be located within 20 feet (6096 mm) of a street intersection, or placed so as to obstruct normal observations of traffic signals or to hinder the use of public transit loading platforms.

780 CMR 3313.0 REMOVAL OF WASTE MATERIAL

3313.1 General: Material shall not be dropped by gravity or thrown outside the exterior walls of a building during demolition or erection. Wood or metal chutes shall be provided for the removal of such materials. Where the removal of any material will cause an excessive amount of dust, such material shall be wet down to prevent the creation of a nuisance.

780 CMR 3314.0 STAIRWAYS

3314.1 Temporary stairways: Where a building has been constructed to a *height* greater than 50 feet (15240 mm) or four stories, or where an existing building exceeding 50 feet (15240 mm) in *height* is *altered*, at least one temporary lighted stairway shall be provided unless one or more of the permanent stairways are erected as the construction progresses.

780 CMR 3315.0 LIGHTING

3315.1 General: All *stairways* and parts of buildings under demolition, erection or repair shall be adequately lighted while persons are engaged at work, in accordance with the provisions of 780 CMR 1024.0 and ***527 CMR 12.00***.

CHAPTER 34

REPAIR, ALTERATION, ADDITION, AND CHANGE OF USE OF EXISTING BUILDINGS

(780 CMR 34 is entirely unique to Massachusetts)

780 CMR 3400.0 SCOPE

3400.1 General: The provisions of 780 CMR 34 are intended to maintain or increase public safety, health, and general welfare in existing buildings by permitting repair, alteration, addition, and/or change of use without requiring full compliance with the code for new construction except where otherwise specified in 780 CMR 34.

3400.2 Compliance: Repairs, alterations, additions, and changes of use shall conform to the requirements of 780 CMR 34. Where compliance with the provisions of this code for new construction is required by 780 CMR 34, and where such compliance is impractical because of construction difficulties or regulatory conflicts, *compliance alternatives* as described in 780 CMR 3406.0 may be accepted by the *building official*.

> **Note**: Specialized codes, rules, regulations, and laws pertaining to repair, alteration, addition, or change of use of existing buildings promulgated by various authorized agencies may impact upon the provisions of 780 CMR 34. Specialized state codes, rules, regulations, and laws include, but are not limited to those listed in ***Appendix A***.

3400.3 Applicability: The provisions of 780 CMR 34 apply to repair, alteration addition or change in use to existing buildings which qualify to use 780 CMR 34 (see 780 CMR 3400.3.1), based on the proposed continuation of, or change in use group, as follows:

1. Continuation of the same *use group*, or a change in *use group* which results in a change in *hazard index* of one or less as determined by 780 CMR 3403 shall comply with 780 CMR 3404.0.
2. Change in use group to a use group with *hazard index* of two or more greater than the *hazard index* of the existing use shall comply with the requirements of 780 CMR 3405.0 and the code for new construction.
3. **Part change in use (Mixed Use)**: Portions of the building is changed to a new *use group*, shall be separated from the remainder of the building with *fire separation assemblies* complying with 780 CMR 313, or with approved *compliance alternatives*. The portion of the building changed shall be made to conform with the applicable provisions of 780 CMR 34.
4. **Additions**: Additions to *existing buildings* shall comply with all code requirements for new construction, except as otherwise provided in 780 CMR 34. The combined height and area of the *existing building* and the addition shall not exceed that allowed by 780 CMR 503.0 and Table 503 as modified by 780 CMR 504 and 506. Where a *fire wall* complying with 780 CMR 707.0 and 708.0 is provided, the addition shall be considered as a separate building.
5. *Ordinary repairs*: *Ordinary repairs* conforming to 780 CMR 110.3 (4), 780 CMR 2 and 780 CMR 902 may be performed without a building permit.
6. **Assembly use groups**: A change from any other use group to an assembly use group (A) or any alteration or change in occupancy within an assembly use group shall comply with the requirements of the code for new construction, except that earthquake requirements need only conform to 780 CMR 3408.
7. **Institutional use groups**: A change from any other use group to an institutional use group (I) or any alteration or change in occupancy within an institutional use group shall comply with the requirements of the code for new construction, except that earthquake requirements need only conform to 780 CMR 3408.
8. **Residential use groups**: A change from any other use group to a residential use group (R) or any alteration or change in occupancy within an residential use group shall comply with the requirements of the code for new construction, except that earthquake requirements need only conform to 780 CMR 3408.
9. ***Historic buildings***: Buildings which qualify as *totally or partially preserved historic buildings* in accordance with 780 CMR 3409 shall meet the provisions of 780 CMR 3409.
10. **Structural requirements**: Structural requirements for additions, and for existing buildings subject to repair, alteration, and/or change of use, shall be in accordance with 780 CMR 3408, except:
    a. *Totally Preserved Historic Buildings* need not comply with the wind load and seismic load requirements of 780 CMR 3408; and
    b. *Partially Preserved Historic Buildings* need not comply with the seismic load requirements of 780 CMR 3408.

3400.3.1 Buildings which qualify: The provisions of 780 CMR 34 shall apply to *existing buildings* which have been legally occupied and/or used for a period of at least five years. Any building for which there exists an outstanding notice of violation or other order of the building official shall not qualify to use 780 CMR 34 unless such proposed work includes the abatement of all outstanding violations and compliance with all outstanding orders of the building official. Buildings which do not qualify as *existing buildings* for the purposes of 780 CMR 34 shall comply fully with the applicable provisions of this code for new construction.

Exceptions:

(1) *Existing buildings* or portions thereof which are changed in use from any other use group to day care centers (I-2 or E) shall not qualify as *existing buildings* for the purposes of 780 CMR 34, but shall comply with the requirements of 780 CMR 4, as applicable.

(2) *Existing buildings* or portions thereof, which are changed in use from any use to a Group Residence, Limited Group Residence or Group Dwelling Unit shall not qualify as *existing buildings* for the purposes of 780 CMR 34, but shall comply with the provisions of 780 CMR 4, as applicable.

3400.4 Special Provisions for Means of Egress:

3400.4.1 Existing Non Conforming Means of Egress: The following conditions, when observed by the *building official*, shall be cited, in writing as a violation. Said citation shall order the abatement of the non conformance and shall include such a time element as the building official deems necessary for the protection of the occupants thereof, or as otherwise provided for by statute.

1. Less than the number of *means of egress* serving every space and/or story, required by 780 CMR 1010.0 and Table 1010.2, or 780 CMR 36 for one and two family dwellings.
2. Any required *means of egress* component which is not of sufficient width to comply with 780 CMR 1009, or is not so arranged as to provide safe and adequate *means of egress*, including exit signage and emergency lighting.

3400.5 *Hazardous Means of Egress*:

3400.5.1 Exit Order/Hazardous *Means of Egress*: In any *existing building* or structure not provided with exit facilities as herein prescribed for new buildings and in which the exits are deemed hazardous or dangerous to life and limb, the *building official* shall declare such building dangerous and unsafe in accordance with the provisions of 780 CMR 121.0.

3400.5.2 Appeal from exit order: Any person served with any order pursuant to 780 CMR 3400.5 shall have the remedy prescribed in 780 CMR 121.

3400.6 Unsafe Lighting and/or Unsafe Ventilation: In any *existing building* , or portion thereof, in which (a) the light or ventilation do not meet the applicable provisions of 780 CMR 12.0 and (b) which, in the opinion of the *building official*, are dangerous, or hazardous, to the health and safety of the occupants, the *building official* shall order the abatement of such conditions to render the building or structure occupiable or habitable as applicable for the posted use and occupant load.

In enforcing the provisions of 780 CMR 3400.6 the *building official* may require or accept engineering or other evaluations of the lighting and/or ventilation systems in order to evaluate possible dangerous or hazardous conditions and acceptable solutions.

Where full compliance with 780 CMR for new construction is not practical for structural and/or other technical reasons, the *building official* may accept compliance alternatives, or engineering or other evaluations which adequately address the building or structure livability for the posted use and occupant load.

780 CMR 3401.0 DEFINITIONS

3401.1 General: Definitions shall, for the purposes of 780 CMR 3401.0, have the meaning shown herein:

Building System: Any mechanical, structural, egress, electrical, plumbing, building enclosure and/or fire protection system, or fire resistive construction system, or portion thereof.

Building System Component: A part or portion of a *building system.*

Compliance Alternative: An alternative life-safety construction feature which meets or exceeds the requirements or intent of a specific provision of 780 CMR. The *Building Official* is authorized to approve or disapprove *compliance alternatives. Compliance alternatives* are only permitted for *existing buildings*.

Existing building or structure: Any building or structure qualifying under 780 CMR 3400.3.1.

Hazard Index: A numerical value, between 1 and 8, which is assigned to a specific *Use Group* in order to determine which of the provisions of 780 CMR 34 apply to the proposed work on the *existing building*. The *Hazard Index* is a relative scale used only to determine applicable provisions of 780 CMR 34. *Hazard indices* are listed in Table 3403 and *Appendix F*.

Historic buildings: (a) Any building or structure individually listed on the National Register of Historic Places or (b) any building or structure evaluated by MHC to be a contributing building within a National Register or State Register District. (c) any building or structure which has been certified by the Massachusetts Historical Commission to meet eligibility requirements for individual listing on the National Register of

Historic Places. Historic building shall be further defined as totally or partially preserved buildings. All entries into the totally preserved building list shall be certified by the Massachusetts Historical Commission. The Board of Building Regulations and Standards shall ratify all buildings or structures certified by the Massachusetts Historical Commission to qualify for *totally preserved* listing (see Appendix H).

Partially preserved buildings: (a) Any building or structure individually listed on the National Register of Historic Places or (b) any building or structure certified as a historic building by the Massachusetts Historical (Commission/t and not designated a *totally preserved building* in *Appendix H*.

Restoration: *Restoration* is the process of accurately reconstructing or repairing the forms and details of a building or structure or portion thereof as it appeared at a particular period or periods of time by means of removal of later work/or the replacement of missing original work

Totally preserved buildings: A *totally preserved building* is an *historic building* or structure. The principal use of such a building or structure must be as an exhibit of the building or the structure itself which is open to the public not less than 12 days per year, although additional uses, original and/ or ancillary to the principal use shall be permitted within the same building up to maximum of 40% of the gross floor area. *Totally preserved buildings* shall be those listed in *Appendix H*. All entries into the *totally preserved building* list shall be certified by the Massachusetts Historical Commission. The Board of Building Regulations and Standards shall ratify all buildings or structures certified by the Massachusetts Historical Commission to qualify for *totally preserved* listing (See *Appendix H*).

Seismic Hazard Category: A numerical value, between 1 and 3, which is based on a proposed change in use, change in occupancy and cost of alterations in order to determine which of the provisions of 780 CMR 3408 apply to the proposed work on the *existing building*. The *Seismic Hazard Category* is a relative scale used only to determine applicable provisions of 780 CMR 34. *Seismic Hazard Categories* are listed in Table 3408.1

Substantial Renovation, or Substantial Alteration: The terms *substantial renovation* and *substantial alteration* are defined herein for the specific purpose of determining whether fire protective systems are required in existing buildings, when such buildings undergo renovations or alterations, change in use or occupancy or additions. As used in 780 CMR 34, *substantial renovation* or *substantial alteration* shall have the following meanings; S*ubstantial renovation* and *substantial alteration* is work which is major in scope *and* expenditure when compared to the work and expenditure required for the installation of a fire protection system, when such system is required by 780 CMR 9 for a particular *use group*. The *building official* shall make such determination and may request the owner or applicant to provide such supporting information as is necessary to make such determination

780 CMR 3402.0 IMPLEMENTATION

3402.1 Building Permit Application Requirements for *Existing Buildings*: A building permit shall be required for any work regulated by 780 CMR 34.

Exception: *Ordinary repairs* may be performed without a building permit.

3402.1.1 Investigation and evaluation: For any proposed work regulated by 780 CMR 34, which is subject to 780 CMR 116, as a condition of the issuance of a building permit the building owner shall cause the *existing building* (or portion thereof) to be investigated and evaluated in accordance with the provisions of 780 CMR 34 (see Appendix F).

The investigation and evaluation shall be in sufficient detail to ascertain the effects of the proposed work (if any) on the structural, egress, fire protection, energy conservation systems and light and ventilation systems of the space under consideration and, where necessary, the entire building or structure.

3402.1.2 Submittal: The results of the investigation and evaluation, along with any proposed *compliance alternatives*, shall be submitted to the *building official* in written report form.

3402.1.3 Non Conformities and *Compliance Alternatives*: The application for a building permit shall identify all items of non or partial compliance with the requirements of 780 CMR 34, and *compliance alternatives*, if any are proposed, for approval by the building official. The *building official* shall respond to the acceptability of any proposed *compliance alternatives* within 30 days of the filing of the building permit application. Where proposed *compliance alternatives* are, in the opinion of the *building official*, unacceptable, or where issues of non-compliance remain, the permit applicant shall have the remedies prescribed by 780 CMR 122.0.

3402.1.5 Documentation of *compliance alternatives*: Whenever action is taken on any building permit application to repair, make alterations or additions, or change the use or occupancy of an existing building, and when said application proposes the use of *compliance alternatives*, the building official shall ensure that one copy of the proposed *compliance alternatives*, including applicable plans, test data, or other data for evaluation, be submitted to the BBRS, together with a copy of the building permit application and the *building official's* decision regarding the proposed *compliance alternatives*.

780 CMR 3403.0 *HAZARD INDEX*

3403.1 ***Hazard Index***: In the implementation of the provisions of 780 CMR 34, the *hazard index* associated with a particular use group shall be as identified in table 3403 and Appendix F. In order to determine the applicable provisions of 780 CMR 34 the *hazard index* of the existing *use group* shall be subtracted from the *hazard index* of the proposed use The algebraic difference shall be used to determine the applicable provisions of 780 CMR 34.

Table 3403
HAZARD INDEX

USE GROUP(1)	DESCRIPTION	HAZARD INDEX NO.(2)
A-1	Theater with stage	6
A-2	Night Club	7
A-3	Theater without stage	5
A-3	Restaurant	5
A-3	Lecture halls, recreations centers, museums, libraries. similar assembly buildings	4
A-4	Churches	4
B	Business	2
E	Educational (K through 12)	4
F	Factory and industrial	3
H	High hazard	8
I-1, I-3	Institutional restrained	5
I-2	Institutional incapacitated	4
M	Mercantile	3
R-1	Hotels, motels	2
R-2	Multi-family	2
R-3	One and two family	2
S-1	Storage, moderate hazard	3
S-2	Storage, low hazard	1

Notes to Table 3403:

(1) See 780 CMR 3 and 4 and Appendix F.

(2) Hazard Index Modifier for selected construction types as follows:

(a) When a building is classified in construction Type 1A, 1B, 2A, or 2B, subtract one from the *Hazard index* shown in Table 3403 for the applicable proposed new use group only.

(b) When a building is classified in construction Type 2C or 5B, add one to the *Hazard index* shown in Table 3403 for the applicable proposed new use group only. Exception: *Partially Preserved Historic Buildings* (780 CMR 3409).

780 CMR 3404.0 REQUIREMENTS FOR CONTINUATION OF THE SAME *USE GROUP* OR CHANGE TO A *USE GROUP* RESULTING IN A CHANGE IN *HAZARD INDEX* OF ONE OR LESS

3404.1 General: The requirements of 780 CMR 3404.0 and applicable provisions of 780 CMR 3408 shall apply to all repairs and alterations to *existing buildings* having a continuation of the same use group or to *existing buildings* changed in use group of one or less *hazard index* (Table 3403).

3404.2 Requirements exceeding those required for new construction: *Existing buildings* which, in part or as a whole, exceed the requirements of 780 CMR may be altered, in the course of compliance with 780 CMR 34, so as to reduce or remove, in part or completely, features not required by this code for new construction.

> **Exception**: Pursuant to M.G.L. c. 148, § 27A, fire protection devices, shall not be disconnected (temporarily or permanently), obstructed, removed or shut off or destroyed without first procuring a written permit from the head of the local fire department.

3404.3 New *building systems*: Any new *building system* or portion thereof shall conform to 780 CMR for new construction to the fullest extent practical. However, individual *components* of an existing *building system* may be repaired or replaced without requiring that system to comply fully with the code for new construction unless specifically required by 780 CMR 3408

3404.4 Alterations and repairs: Alterations or repairs to *existing buildings* which maintain or improve the performance of the building may be made with the same or like materials, unless required otherwise by 780 CMR 3408. Alterations or repairs which have the effect of replacing a *building system* as a whole shall comply with 780 CMR 3404.3

3404.5 Number of *Means of Egress*: Every floor or story of any existing building shall provide at least the number of *means of egress* as required by 780 CMR 3400.4 and which are acceptable to the *building official*.

3404.6 Capacity of exits: All required *means of egress* shall comply with 780 CMR 1009.0. Existing *means of egress* may be used to contribute to the total egress capacity requirement based on the unit egress widths of 780 CMR 1009.0.

3404.7 Exit signs and lights: Exit signs and lighting shall be provided in accordance with 780 CMR 1023.0.

3404.8 Means of egress lighting: *Means of egress* lighting shall be provided in accordance with 780 CMR 1024.0.

3404.9 Height and Area limitations: The height and area requirements of 780 CMR 5 shall apply to *existing buildings* when such *existing buildings* are modified by addition and/or change in use. Modifications to the height and area requirements as provided in 780 CMR 504.0 and 506.0 are permitted.

3404.10 Existing Fire and party walls: No further compliance is required with 780 CMR 707.0. The height above the roof of existing fire, party and exterior walls need not comply with 780 CMR 3404.0

3404.11 Fire Protection Systems: Fire Protection Systems: Design, installation and maintenance of fire protection systems shall be provided in accordance with 780 CMR 3404.3 and 780 CMR 3404.12 as applicable.

3404.12 Fire protection systems are required for the following cases:

1. Additions where required by 780 CMR 9.0 for the specific *use group.*
2. For *existing buildings* and additions to *existing buildings,* where required by 780 CMR 9 or where required by 780 CMR 506 to satisfy height and area requirements.
3. *Existing buildings*, or portions thereof which are *substantially altered* or *substantially renovated*, and where otherwise required by 780 CMR 9.0 for the specific *use group.*
4. Existing buildings or portions thereof when changed in use to an A-2 occupancy shall be protected with an automatic fire suppression system. Where the A-2 occupancy is created in a mixed-use building, the A-2 occupancy, including all ingress and egress portions shall require automatic fire suppression when the A-2 occupant load is 50 or greater; additionally in such mixed use, the A-2 occupancy shall be separated from adjacent uses by one hour horizontal and vertical fire separation assemblies in accordance with 780 CMR 709.

Note: Notwithstanding the provisions of 780 CMR 3404.12, automatic Fire Suppression systems are required in municipalities which have adopted the provisions of M.G.L. c. 148, § 26G, H or I; also see M.G.L. c. 143, § 97A, M.G.L. c. 148, § 26G½ and M.G.L. c. 148A relative to statutory prospective and retroactive sprinkler requirements for nightclubs and similar USES.

3404.13 Enclosure of stairways: Open stairways are prohibited except in one- and two-family dwellings or unless otherwise permitted by 780 CMR 10. There shall be no minimum fireresistance rating required for an existing enclosure of a stairway. Partitions or other new construction which is added in order to fully and solidly enclose a stairway shall provide a minimum fireresistance rating of one hour. All doors in the enclosure shall be self-closing and tight-fitting with approved hardware. All doors in those portions of the stairway which are fireresistance rated shall comply to the applicable provisions of 780 CMR 9.

3404.14 Assembly Use Groups: Notwithstanding the provisions of 780 CMR 3404, Assembly Use Groups shall comply with the provisions of 780 CMR 3400.3, item 6.

3404.15 Institutional Use Groups: Notwithstanding the provisions of 780 CMR 3404, Institutional Use Groups shall comply with the provisions of 780 CMR 3400.3, item 7.

3404.16 Residential Use Groups: Notwithstanding the provisions of 780 CMR 3404, Residential Use Groups shall comply with the provisions of 780 CMR 3400.3, item 8.

3404.17 Fire hazard to adjacent buildings: Any proposed change in the use or occupancy of an existing building which has the effect of increasing the fire hazard to adjacent buildings shall comply with the requirements of Table 705.2 for exterior wall fire resistance rating requirements, or with approved *compliance alternatives*.

3404.18 Accessibility for Persons with Disabilities: Accessibility requirements shall be in accordance with 521 CMR as listed in *Appendix A*.

3404.19 Energy Conservation: Energy conservation requirements shall be in accordance with 780 CMR 3407.0.

780 CMR 3405.0 REQUIREMENT FOR CHANGE IN *USE GROUP* TO TWO OR MORE *HAZARD INDICES* GREATER

3405.1 General: When the existing use group is changed to a new use group of two or more hazard indices higher (as provided in Table 3403), the existing building shall conform to the requirements of the code for new construction, except as provided in 780 CMR 3408 or as otherwise allowed in 780 CMR 3407.0.

3405.2 Accessibility for Persons with Disabilities: Accessibility requirements shall be in accordance with 521 CMR as listed in ***Appendix A***.

780 CMR 3406.0 *COMPLIANCE ALTERNATIVES*

3406.1. General: Where compliance with the provisions of the code for new construction, required by 780 CMR 34, is impractical because of construction difficulties or regulatory conflicts, *compliance alternatives* may be accepted by the building official.

> Examples of *compliance alternatives* which have been used are provided in *Appendix F*. The building official may accept these *compliance alternatives* or others proposed.

3406.2 Documentation: In accordance with 780 CMR 3402.1.5, the building official shall ensure that the BBRS is provided with information regarding *compliance alternatives* accepted or rejected by the *building official.*

780 CMR 3407.0 ENERGY PROVISIONS FOR *EXISTING BUILDINGS*

Implementation date: Note that commencing January 1, 1999, replacement windows for existing low-rise residential buildings are required to have a maximum thermal transmittance of 0.44 and such windows must be NFRC listed/labeled.

> **Exception 1**: Criteria for NFRC listing/labeling and maximum U-0.44 are not required if the existing window (s) are true divided light (i.e. – single thickness multi-pane sashes with structural muntin bars) and being replaced with "like kind" units. This Exception additionally requires that a storm window be installed over the replacement window. The storm window may be installed internally, externally, or integrated with the primary window.
>
> **Exception 2**: Criteria for NFRC listing/labeling and maximum U-0.44 are not required for basement windows with a unit height up to 24 inches, whether or not the basement is a conditioned space.

3407.1 General: 780 CMR 3407.0 establishes the energy provisions for *existing buildings* governed by 780 CMR 3404.0 or 780 CMR 3405.0.

3407.2 Compliance: Alterations to any building component affecting the energy conservation performance of an existing building shall comply with the applicable requirements of::

(a) 780 CMR, Table 3407 (COMPONENT VALUES FOR ALTERED ELEMENTS) and all applicable subsections of 780 CMR 13.0, or:

(b) 780 CMR 1304.2 for thermal envelope requirements and all other applicable requirements of 780 CMR 13.0, or:

(c) 780 CMR 1304.5 for thermal envelope requirements and all other applicable requirements of 780 CMR 13.0, or:

(d) 780 CMR 1309, or:

(e) 780 CMR Appendix J, as applicable.

3407.3 Exempt buildings: Refer to 780 CMR 1301.4 for thermally exempt buildings and 780 CMR 1308.1 for lighting exemptions.

3407.4 Compliance exceptions

3407.4.1 Fenestration: When alterations to a wall assembly include only altering the fenestration component, the areas of fenestration may be decreased or replaced with an opaque wall element made to comply with the thermal transmittance value of the existing wall.

3407.4.2 ***Ordinary repairs***: *Ordinary repairs* need not comply with the energy provisions.

> Note that in the repair of broken windows, broken doors or broken skylights, like-kind replacement shall be allowed, but the complete replacement of windows, doors or skylights in an *existing building* shall require compliance with the applicable requirements of 780 CMR 3407.2. Any window replacement that includes new jambs or new jamb liners does not qualify as an "ordinary repair," and such replacement is subject to the energy performance criteria of 780 CMR, 3407.2.

3407.4.3 Roofs: Compliance of the roof/ceiling assembly is not required unless the existing roofing material is stripped off the roof deck. However, if a structural analysis by a registered professional engineer shows that the roof will not support the additional live loads imposed by compliance of the roof/ceiling assembly, or, if such analysis shows that addition of the required amount of insulation will cause ponding of water, then compliance of the roof/ceiling assembly is not required.

#324

THE COMMONWEALTH OF MASSACHUSETTS

William Francis Galvin
Secretary of the Commonwealth

Notice of Compliance

Regulation Filing *To be completed by filing agency*

CHAPTER NUMBER: 780 CMR Appendix A

CHAPTER TITLE: Referenced Standards

AGENCY: Department of Public Safety / Board of Building Regulations and Standards

THIS REGULATION WAS ORIGINALLY ADOPTED AS AN EMERGENCY:

Published in Massachusetts Register Number: #1034 *Date:* 9/9/05

PRIOR NOTIFICATION AND/OR APPROVAL - *If prior notification to and/or approval of the Governor, Legislature or others was required, list each notification, and/or approval and date, including notice to the Local Government Advisory Commission.*

Local Government Notice on 4/21/04 and 10/18/04, respectively

PUBLIC REVIEW- *M.G.L. c. 30A, §§ 2 and/or 3 requires notice of the hearing or comment period to be filed with the Secretary of the Commonwealth, published in appropriate newspapers, and sent to persons whom specific notice must be given at least 21 days prior to such hearing or comment period.*

Date of public hearing or comment period: Comment Period thru 6/11/04 and 12/9/04 respectively

Publication - *To be completed by the Regulations Division*

MASSACHUSETTS REGISTER NUMBER: #1034 DATE: 9/9/05

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CODE OF MASSACHUSETTS REGULATIONS

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William Francis Galvin

WILLIAM FRANCIS GALVIN
SECRETARY OF THE COMMONWEALTH

DATE 8/26/05 CLERK

TABLE 3407
COMPONENT VALUES FOR ALTERED ELEMENTS

WALLS	All wall construction containing heated or mechanically cooled space	U-0.08	6,8
Foundation Walls Including Band	Containing heated or mechanically cooled space Containing unheated space	U-0.08 U-0.17	4
Roof/Ceiling Assembly	Wood plank and beam construction containing heated or mechanically cooled space	U-0.08	1
Roof/Ceiling Assembly	Construction other than wood plank and beam containing heated or mechanically cooled space	0.05	
Windows and Skylights	All construction enclosing heated or mechanically cooled space	For windows, see Note 2. For skylights - no current restriction on "U" value	2, 5 6, 7
Floors	Floor sections over area exposed to outside air or unheated areas Unheated slab on grade Heated slab on grade	U-0.08 R-5.50 R-7.75	3
Mechanical Equipment	Heating, cooling, sizing and efficiency	780 CMR 1305.0	9
Equipment Controls	Humidistats, thermostats & zoning	780 CMR 1305.0,	9
Duct and Pipe Insulation and Construction	Located in or on buildings	780 CMR 1305.0	
Electrical Power Distribution.	-	780 CMR 1307.0	
Lighting	Lighting	780 CMR 1308.0	

Note 1. Wood plank and beam assemblies are constructions in which the finished interior surface is the underside of the roof deck.

Note 2. For existing low-rise residential buildings, commencing January 1, 1999, the maximum allowed thermal transmittance of replacement windows, with or without a storm window, shall be 0.44 and such windows and window with storm window combinations will be NFRC listed labeled. For all other existing building types (commercial/high-rise), window thermal transmittance requirements shall conform to the requirements of 780 CMR 13 generally and 780 CMR 1304.2 or 1304.5 or 1309, as applicable. Refer also to 780 CMR 3407.0 Exceptions 1 and 2.

Note 3. Insulation may be omitted from floors over unheated areas when foundation walls are provided with a U value of 0.17.

Note 4. The U value requirement of 0.17 for foundation walls may be omitted when floors over unheated spaces are provided with a U value of 0.08.

Note 5. Refer to 780 CMR Appendix J Table J4.3.2 for allowable air infiltration rates for residential doors and windows. Allowable rate for commercial doors is 11 cfm/lin. ft of operable sash crack.

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Note 6. The first floor exterior envelope of business and mercantile use groups shall have an overall thermal transmittance value not greater than .65 in lieu of individual component values for walls and fenestration.
Note 7. When the glass area is increased, the glass and wall components which are altered shall comply with the component values in Table 3407. The extent of wall made to comply shall be equivalent to the decreased opaque wall area.
Note 8. When any alterations to the exterior wall component exposes the wall cavity or, when a finished system is added to a wall having no cavity, the wall must comply with the values in Table 3407.
Note 9. When mechanical system compliance is required on an existing system, only the portions of the system altered and any other portions which can reasonably be incorporated need comply.

780 CMR 3408.0 STRUCTURAL REQUIREMENTS FOR *EXISTING BUILDINGS*

3408.1General Requirements:

3408.1.1 Buildings Constructed on or after January 1, 1975: The structural systems of *existing buildings* which were constructed under a building permit issued on or after January 1, 1975 shall conform to the requirements for new construction of either the current edition of 780 CMR (the Massachusetts State Building Code), or to the edition in effect on the date of the permit plus applicable provisions of 780 CMR 3408.0 of the current edition of the code. Provisions of 780 CMR 3408.0 which are less stringent than the code in effect on the date of the permit shall not apply.

3408.1.2 Buildings Constructed prior to January 1, 1975: The structural systems of existing buildings constructed under a building permit issued prior to January 1, 1975 shall conform to 780 CMR 3408.0 and the building code applicable at the time of the original building permit. In the event of conflict between the prior code and 780 CMR 3408.0, the provisions of 780 CMR 3408.0 shall govern.

3408.1.3 Structural Engineering Services: For buildings subject to construction control, as determined in 780 CMR 116, the Owner shall retain *a registered professional engineer* qualified in the structural design of buildings (hereinafter called the structural engineer) to perform all structural engineering required by 780 CMR. For purposes of determining applicability of construction control, the volume of enclosed space shall include the entire existing building and all proposed additions. (See 780 CMR 116.1 for buildings exempt from construction control.)

3408.2 Evaluation of *Existing Buildings*: The structural engineer shall make a structural evaluation of the *existing building* to determine the adequacy of all structural systems that are affected by alteration, addition, change of use, or damage to be repaired. The evaluation shall include review of relevant available documentation about the building design and construction, a field investigation of the existing conditions, and a structural analysis. When deemed necessary by the structural engineer, the evaluation shall also include detailed field surveys, testing, and laboratory analysis. Refer to 780 CMR F-104 in *Appendix F*. When new structural elements or strengthening of existing elements is necessary, the evaluation shall include the effects of such new elements and strengthening. A report on the structural evaluation shall be submitted to the building official with the application for the building permit.

3408.2.1 Field Investigation: The field investigation of an *existing building* shall be sufficient to determine the location, size, details, and conditions of existing structural elements, and to verify structural information on the drawings of the existing building, if said drawings exist.

3408.2.2 Structural Analysis: The structural analysis shall include analysis of all structural systems affected by the proposed alteration, addition, change in use or repair, or for which design loads are specified in 780 CMR 3408, and shall be adequate to demonstrate the ability of new and existing systems to support the required loads.

3408.2.3 Field Observations During Construction: The structural engineer shall make periodic field visits during the progress of the construction work on the existing building in order to observe and verify the assumed conditions on which the structural design was based, and shall modify the design should the observed conditions differ in any significant manner from those on which the structural design was based. The structural engineer shall provide a written notification to the building official of changes to the contract documents as shown on the permit application.

3408.2.4 Geotechnical Explorations: Explorations shall be performed as necessary to determine the subsoils and the type and condition of existing foundations for the lateral load analysis of foundations required in 780 CMR 3408.3.4 and for the liquefaction evaluation required in 780 CMR 3408.7.

3408.3 General Structural Design Requirements: The provisions of 780 CMR 3408.3 shall apply to the structural analysis and design of additions, alterations, changes in use, and repairs to *existing buildings*. Specific requirements for additions, and for alterations or changes of use, or repairs are prescribed in 780 CMR 3408.4 and 3408.5

respectively. Additional requirements for earthquake analysis and design are prescribed in 780 CMR 3408.6.

3408.3.1 New Structural Members and Systems: All new structural elements and systems, whether in new additions or in existing construction, shall be designed and constructed in accordance with the code requirements for new construction using the loads and criteria specified in 780 CMR 3408.0.

3408.3.2 Existing Structural Members and Systems: Strength of existing systems, elements, and connections shall be determined in accordance with current accepted engineering practice, using the actual strength and other physical properties of the existing materials. Alternatively, except for earthquake design, applicable design codes at the time of construction may be used to determine the strength of existing systems, elements and connections, provided that the allowable stresses specified in those codes are not exceeded, and provided the applicable provisions of those codes have not since been found to endanger public safety.

3408.3.2.1 Strength of Existing Materials: The strength of existing materials shall be determined by tests or from generally accepted historical records.

3408.3.2.2 Reuse of Existing Structural Members: Existing structural members in sound structural condition may be reused, providing analysis in accordance with 780 CMR 3408.3.2 demonstrates adequate capacity to support the loads required by 780 CMR 3408.0.

3408.3.3 Reinforcement and Repair of Existing Construction: Repair or reinforcement of existing structural elements or systems shall be designed and constructed in accordance with the code requirements for new construction, using the loads and criteria specified in 780 CMR 3408.0, and in the case of existing materials, using the actual physical properties of the existing materials. Alternatively, for other than earthquake design, design codes applicable at the time of construction of the existing building may be used, provided that the allowable stresses specified in those codes are not exceeded, and provided the applicable provisions of those codes have not since been found to endanger public safety.

3408.3.4 Lateral Load Analysis: Lateral load analysis of a building required by the provisions of 780 CMR 3408.0 shall:

1. Consider all walls, frames, diaphragms, and other structural elements that may contribute to lateral load resistance.
2. Consider eccentricity of center of applied wind load from center of rigidity of the structure.
3. Consider relative stiffnesses of resisting elements.
4. Consider flexibility of diaphragms where appropriate.
5. Include calculations of total lateral earthquake force as prescribed in 780 CMR 3408.6.1.
6. Include calculations of distribution of lateral earthquake force as in 780 CMR 1612.5.2, of horizontal torsional moments as in 780 CMR 1612.5.3, of overturning as in 780 CMR 1612.5.4, and of lateral forces on foundations and retaining walls as in 780 CMR 1612.4.9.

3408.3.5 Existing Lateral Load Capacity: Alterations shall not be made to elements or systems contributing to the lateral load resistance of a building which would reduce their capacity to resist lateral loads, unless a structural analysis conforming to 780 CMR 3408.3.4 shows:

1. That the lateral load resisting system of the building as altered conforms to 780 CMR 1611.0 and 1612.0 of the code for new construction, or
2. That the lateral load resisting system as altered conforms to all applicable minimum load requirements of 780 CMR 3408, and that there is no reduction in the lateral load capacity of the building as a whole.

Existing elements or systems may be reinforced or replaced with new elements or systems of equivalent strength and stiffness, in order to meet these requirements.

A building which complies with 780 CMR 1611.0 and 1612.0 except that the lateral load resisting system does not conform to the detailing requirements of 780 CMR 19 through 23 for the structural materials and seismic load resisting system employed, may be considered to be in compliance with 780 CMR 3408.3.5 if the lateral load resisting system can safely resist a lateral force calculated in accordance with the formulae in 780 CMR 1612.4, but with lateral force factors (R) and force modification factors as stipulated in Tables 3408.2 and 3408.3, respectively.

3408.3.6 Load Combinations: The loads specified in 780 CMR 3408.0 shall be combined in accordance with 780 CMR 1616.0.

3408.3.7 Live Load Reduction: Live loads specified in 780 CMR 3408.0 may be reduced as permitted in 780 CMR 1608.0.

3408.3.8 Deficient or Damaged Structural Members: Existing structural members that are found to be deficient or damaged, either prior to or during an alteration or addition, shall be repaired, replaced, or reinforced so that their load capacities conform to the requirements of 780 CMR 3408.5. Existing structural members shall be considered deteriorated or damaged if their capacity is less than 85% of the strength required by 780 CMR 3408.1.1 or 3408.1.2, as applicable.

3408.4 Additions:

3408.4.1 Live, Dead, Snow and Special Loads: Additions shall be designed to support the live load, dead, snow and special loads specified in 780 CMR 1605.0 through 1610.0 and 1613.0 through 1615.0, inclusive. Where additions are supported on existing construction, the existing structural elements shall be reinforced or replaced, if necessary, to support these loads.

3408.4.1.1 Snow Drifts and Sliding Snow: Where the geometry of an addition may cause snow drifting or sliding snow on existing adjacent construction, the affected existing construction shall be reinforced so that it will support the snow loads specified in 780 CMR 1610.0.

3408.4.2 Wind Loads:

3408.4.2.1 Structure-As-A-Whole: When the aggregate of all additions made to a building since January 1, 1975 produce effects due to the wind loads specified in 780 CMR 1611.0 that are more than 10% of the capacity of the existing lateral load resisting system of the building, a lateral load resisting system shall be provided so that the structure-as-a-whole will resist the wind loads specified in 780 CMR 1611.0. When such effects due to wind are less than 10% of the capacity of the existing lateral load resisting system, a lateral load resisting system shall be provided, where necessary, so that the structure-as-whole will resist the wind loads specified for Exposure A in 780 CMR 1611.0. Where portions of a building are structurally independent, the above requirement shall apply to each structurally independent portion.

3408.4.2.2 Walls and Roofs: New parts of enclosure walls and roofs that are subjected directly to the wind, and their local supporting structural elements, shall be designed to resist the wind loads specified in 780 CMR 1611.0. Existing local supporting structural elements of enclosure walls and roofs that are not altered need not comply with 780 CMR 1611.0.

3408.4.3 Earthquake Loads: All new materials and portions of the structure shall conform to all applicable provisions of 780 CMR 1612.0. Compliance of existing portions of the structure to 780 CMR 1612.0 is not required, except as stipulated in 780 CMR 3408.4.3.1 and 3408.4.3.2.

3408.4.3.1 Structurally Separated Additions: Additions which are structurally separated from the existing portion of the building in accordance with 780 CMR 1612.4.8 shall be considered as separate structures for earthquake design purposes, and shall conform to all provisions of 780 CMR 1612.0. Existing portions of the structure need conform only to 780 CMR 3408.5.

3408.4.3.2 Additions Not Structurally Separated: Existing portions of buildings with new additions which are not structurally separated from the existing structure shall meet the following seismic design criteria:

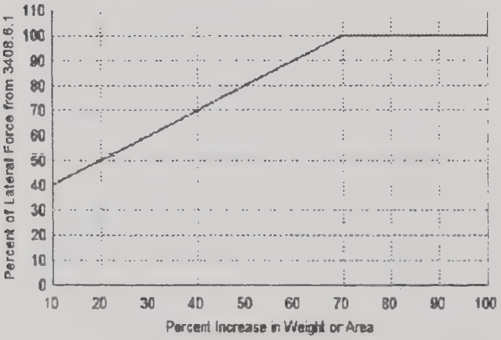
1. If both the area and the weight of the building are increased by less than 10%, earthquake resistance of the existing portion of the building need only comply with requirements of 780 CMR 3408.3.5.
2. If either the area or weight of the building is increased by 10% or more, but neither is increased by more than 100%, the following seismic design criteria shall apply:
   a. The structure shall be designed to resist a percentage of the base earthquake force, calculated in accordance with the requirements of 780 CMR 3408.6.1.1, not less than that given in Figure 3408.1.
   b. Existing structural elements not conforming to the detailing requirements of 780 CMR 19 through 23 may be considered effective in resisting lateral seismic loads, providing that their design seismic force is calculated in accordance with 780 CMR 3408.6.1.
   c. The *existing building* shall be investigated for the presence of special earthquake hazards as described in 780 CMR 3408.6.3, and all such hazards as are present shall be corrected in accordance with the provisions of 780 CMR 3408.6.3.
3. If either the area or weight of the building is increased by more than 100%, the structure as a whole shall comply with the code for new construction. Existing elements that do not conform to the requirements of 780 CMR 19 through 23 shall not be considered effective in resisting lateral seismic loads.
4. For the purposes of 780 CMR 3408.4.3.2, "area" shall mean the total of all gross floor and roof areas supported by the building structure, and "weight" shall have the same meaning as "W" as defined in 780 CMR 1612.5.1. Percentage changes in building area and weight shall be calculated by dividing the total area or weight of the structure after the proposed addition by the total area and weight existing five years prior to the date of the current building permit application.

Figure 3408.1
MINIMUM PERCENTAGE OF LATERAL EARTHQUAKE LOAD

Percent Increase in Weight or Area	Percentage of Lateral Force from 3408.6.1
10	40
20	50
30	60
40	70
50	80
60	90
70	100
80	100
90	100
100	100

3408.4.4 Change in Use: If an addition is accompanied by a change in use, the more stringent requirements for addition or change in use shall apply.

FIGURE 3408.1
MINIMUM PERCENTAGE OF LATERAL EARTHQUAKE LOAD



3408.5 Alterations, Repairs and Changes of Use: The following requirements apply to existing buildings which are altered or repaired, or for which there is a change of use.

3408.5.1 Floor Loads: Except as provided in 780 CMR 3408.5.2, the load capacity of all floors affected by alterations, repairs or changes in use shall be adequate to support the loads required by 780 CMR 1605.0 through 1608.0, 1613.0 and 1614.0, inclusive, or the floors shall be reinforced or replaced with new structural members.

3408.5.2 Posted Live Load: Except for Use Groups, F, I, and S, any existing building in which a new use requires greater live loads may be posted for the originally approved live loads, provided that the use is controlled in a way acceptable to the building official, and so that the public safety is not endangered thereby.

3408.5.3 Wind Loads: The wind load capacity of the structure-as-whole shall not be less than that required for Exposure A in 780 CMR 1611.00. The existing lateral load resisting system shall be reinforced or new lateral load resisting elements or systems shall be added, as necessary, to meet this requirement.

Exception: The building official may waive this requirement if the alterations are minor and if there is not change in use, and if the structural engineer certifies that there are no alterations to structural elements.

3408.5.4 Earthquake Loads:

3408.5.4.1 Seismic Hazard Category for Existing Buildings: The Seismic Hazard Category for existing buildings shall be determined from Table 3408.1 on the basis of the proposed change in use, change in occupancy and cost of alterations.

Table 3408.1
SEISMIC HAZARD CATEGORY

CHANGE IN USE (1)	CHANGE IN OCCUPANCY OR COST OF ALTERATIONS	
	Occupancy increased by more than 25% and to a total occupancy of 100 or more; or total cost of alterations exceeds 50% of the assessed valuation of the building.(2)	All other changes in occupancy, and total cost of alterations less than or equal to 50% of assessed valuation of the building.(2)
Change from Use Group with Hazard Index less than 4 to Use Group with Hazard Index of 4 or greater; or Seismic Hazard Exposure Group III per Table 1612.2.5.	3	2
All other changes in Use Group, or no change in Use Group.	2(3)	1(3)

Note 1. Refer to Table 3403 and Appendix F, Table F-1 for the *Hazard Index* of any use group. Adjustments to the *Hazard Index* indicated in the footnotes to Table 3403 shall not be applied for determination of *Seismic Hazard Category*.

Note 2. Total cost of alterations shall include the cost of alterations proposed under the current building permit application, plus the cost of any alterations covered by building permits in the two-year period preceding the date of the current permit application. The assessed valuation shall be as of the date of the current building permit application.

Note 3. When there is no change in use, the following costs may be excluded from the total cost of alterations:

a. Costs incurred by requirements for compliance with the following:
  i. Americans With Disabilities Act
  ii. Massachusetts Architectural Access Board Regulations, 521 CMR
  iii M.G.L. c. 148, § 26A½ requiring sprinklers in existing high-rise structures.

b.Costs incurred for improvements in:
  i. Sprinklering
  ii. Smoke and heat detection
  iii. Fire alarm systems
  iv. *Exit* enclosures

3408.5.4.2 Partial Change of Use: For buildings in which more than 33% of the total floor area is classified as *Seismic Hazard Category* 2 or 3, the earthquake design of the entire building shall be governed by the requirements applying to that higher *Seismic Hazard Category*.

3408.5.4.3 For *Seismic Hazard Category* 1: Earthquake resistance need only comply with the requirements of 780 CMR 3408.3.5.

3408.5.4.4 For *Seismic Hazard Category* 2: Earthquake resistance shall comply with the requirements of 780 CMR 3408.3.5, and the existing building shall be investigated for the presence of special earthquake hazards as described in 780 CMR 3408.6.3, and all such hazards that are present shall be corrected in accordance with the provisions of 780 CMR 3408.6.3.

3408.5.4.5 For *Seismic Hazard Category* 3: Full compliance with 780 CMR 1612.0 is required, except as provided in 780 CMR 3408.5.4.6 and 3408.6.4, and except that existing structural systems not conforming to the requirements of 780 CMR 19 through 23 may be considered to participate in resisting lateral seismic loads, but only if the seismic design force is calculated in accordance with 780 CMR 3408.6.1.1.

3408.5.4.6 Maximum Lateral Earthquake Force: When the provisions of 780 CMR 3408.5.4 require compliance with the code for new construction, or otherwise require design for minimum lateral seismic force, and the building is not being extended in area or height, the design lateral seismic force need not exceed 75% of the base earthquake force calculated in accordance with 780 CMR 3408.6.1.1.

3408.6:

3408.6.1 R Factors and Force Modification Factors for Existing Construction:

3408.6.1.1 Base Earthquake Force: Where the provisions of 780 CMR require calculation of earthquake design forces on existing buildings, a base earthquake force shall be calculated in accordance with one of the following methods:

1. Where the lateral load resisting system conforms to the requirements of 780 CMR 1612., the base earthquake force shall be calculated using 780 CMR 1612.4 and the appropriate response modification factor R from Table 1612.4.4.
2. Where the lateral load resisting system does not conform to the requirements of 780 CMR 1612:0, the base earthquake force shall be calculated in accordance with 780 CMR 1612.4 except that the appropriate response modification factor R from Table 3408.2 shall be used.
3. Where the lateral load resisting system does not conform to the requirements of 780 CMR 1612.0, and is not adequately described by one of the systems identified in Table 3408.2, the base earthquake force shall be determined by a properly substantiated analysis which takes into account the dynamic and ductility characteristics of the existing structure, and ground motion characteristics consistent with the requirements of 780 CMR 1612.0. The ductility characteristics used in the analysis shall be confirmed by physical tests. If the ductility characteristics of the existing structure cannot be determined, the structure shall be analyzed on the basis of an R factor of 1.25.

3408.6.1.2 Earthquake Design Force: The earthquake design force for the existing lateral load resisting system shall be equal to the base earthquake force calculated in accordance with 780 CMR 3408.6.1.1, multiplied by the appropriate reduction factor from 780 CMR 3408.4.3.2 or 780 CMR 3408.5.4.6, where applicable.

3408.6.1.3 Earthquake Force on Components of Lateral Resisting System: The earthquake design forces for components of the lateral load resisting system shall be determined from the lateral load analysis, based on the earthquake design force calculated in accordance with 780 CMR 3408.6.1.2.

Exception: When the design earthquake force is derived from a base earthquake force calculated in accordance with 780 CMR 3408.6.1.1, Method 2, design forces for components of structural systems which are listed in Table 3408.3 shall be multiplied by a force modification factor as set forth in that Table.

3408.6.2 Existing Rigid Elements in Earthquake Analysis: Existing rigid elements may be assumed not to participate in the lateral load resisting system, provided that their effect on the action of the system is considered and provided for in analysis and design. In addition, the effects of the lateral deflection on such rigid elements themselves and on their attachment to the building structure shall be considered. Where the existing rigid elements are load-bearing elements, such as walls or braced frames, which do not conform to the detailing requirements of 780 CMR 1903, 2104, 2203 or 2306, as applicable:

1. The value of R used in design shall not be greater than 4, and,
2. The lateral stiffness of the building in any story, based on the elements assumed in the design to resist lateral loads, shall not be less than ½ of the stiffness that would pertain if all new and existing elements were considered to be fully effective in resisting lateral loads.

780 CMR 3408.6.2 shall not apply to buildings where the required lateral load resistance is controlled by 780 CMR 3408.3.5.

3408.6.3 Reduction of Earthquake Hazards: Where the provisions of 780 CMR 3408.0. require correction of special earthquake hazards, the following measures shall be taken to reduce hazards from parapets, masonry walls, and/or precast concrete structural elements which do not conform to the requirements of 780 CMR 1612.0:

1. **Parapets**: All parapets not meeting the requirements of 780 CMR 1612.0 shall be removed, or braced so as to meet the requirements of 780 CMR 1612.7 and, for unreinforced masonry parapets, 780 CMR 3408.6.4.
2. **Masonry walls**: All masonry walls shall be connected to floor or roof diaphragms, or other elements providing their lateral support, so as to conform to the requirements of 780 CMR 1612.7. The design force for the connection shall not be less than 100 pounds per linear foot of wall. Connections shall not produce cross-grain bending in wood members.
3. **Precast concrete structural elements**: Interconnections of precast concrete structural elements shall be investigated, and reinforced if necessary. Connections shall conform to the requirements of 780 CMR 19.

Table 3408.2
RESPONSE MODIFICATION FACTOR "R" FOR EXISTING BUILDINGS (1,2)

BUILDING LATERAL FORCE RESISTING SYSTEM	R	C_d
Wood Systems		
Light Framed Plywood Shear Walls 3 Stories or Less	6.5	4
Other Wood Buildings	5	3
Steel Systems		
Steel Moment Frame	4.5	4
Steel Braced Frame without Gravity Loads in Braces	5	4.5
Steel Braced Frame with Gravity Loads in Braces	4	3.5
Steel Frame with Concrete Shear Walls	5.5	5
Cast-in-Place or Precast Concrete Systems		
Concrete Moment Frame	3	2.5
Concrete Frame with Concrete Shear Walls	4.5	4
Unreinforced Concrete Shear Walls	1.5	1.5
Unreinforced Masonry Systems		
Infill Shear Walls in Complete Steel or Concrete Frame(3)	1.5	1.5
Shear Wall Systems with Partial Steel or Concrete Frame	1.38	1.38
Bearing Wall Systems	1.25	1.25

Note 1. See Table 3408.3 for Force Modification Factors applicable to Components of Lateral Force Resisting Systems.

Note 2. For buildings deriving lateral *load* resistance from a combination of structural systems:

a. For vertical combinations with a regular flexible upper portion above a rigid lower portion, perform a two-stage analysis. Evaluate the flexible upper portion as a separate structure supported laterally by the rigid base. Evaluate the base structure as a separate structure, adding the base shear and overturning moment from the upper structures as lateral forces applied at the top of the base structure.

b. For combinations along different horizontal axes, use values of R and C_d for the principal system in the respective directions, except in buildings deriving a significant portion of lateral resistance from bearing walls. For these buildings, use the values of R and C_d associated with the bearing wall system for all directions.

c. For other combinations, use the lowest value of R (and corresponding value of C_d) of all systems participating in lateral *load* resistance.

Note 3. To qualify for a R factor of 1.50, infill walls must bear tightly on surrounding frame members on all four sides. In all other cases, use a R factor of 1.38.

Table 3408.3
FORCE MODIFICATION FACTORS FOR COMPONENTS OF LATERAL LOAD RESISTING SYSTEMS

STRUCTURAL COMPONENT	FORCE MODIFICATION FACTOR (1)
Structural Steel Systems	
All forces in bracing connections not conforming to 780 CMR 2204.3.1.	0.4R
All forces in column connections using partial penetration welds not conforming to relevant portions of 780 CMR 2203.0.	0.8R
All forces in members and connections of open web steel joists resisting earthquake loads.	0.8R
Cast-in-Place and Precast Concrete **Systems**	
Moment at any cross-section of a flexural member where the reinforcing ratio is less than 200/fy, or where the reinforcing consists of less than two bars, or is less than ¼ of the amount of reinforcing in the opposite face of the member.	0.8R
Moment and shear in any beam without closed stirrups at a maximum spacing of d/4 over a distance of 1½d from each end of the clear span.	0.4R
Moment and shear in any column without ties as a spacing not exceeding the smaller of times the diameter of the smallest enclosed bar, 24 tie bar diameters, or ½ the smallest dimension of the member, over a distance from each end of the member not less than 1/6 the clear height of the column, the largest dimension of the member, or 18 inches.	0.8R
Force in concrete shear wall reinforcing with splices that do not develop the full yield stress of the reinforcing in tension.	0.8R
Shear in shear walls not conforming with minimum wall reinforcing requirements.	0.4R
Axial force in any column supporting a discontinuous stiff element, such as a shear wall, resisting axial loads, unless the column has special transverse reinforcement over its full height.	0.8R
All forces in precast concrete connections not conforming to the requirements of 780 CMR 19.	0.8R
All Systems	
Shear in any story where the strength of all shear resisting elements is less than 65% of the strength of all shear resisting elements in the story above.	0.8R

Note 1. Force Modification Factor shall not be less than 1.0.

3408.6.4 Existing Unreinforced Masonry Walls: Where compliance with the code for new construction is required by 780 CMR 3408.0, existing unreinforced masonry walls in sound condition may continue in service, providing:

1. They are adequately tied to the structural elements providing their lateral support; and,
2. The ratio of unbraced height or length to nominal thickness in at least one direction does not exceed 20 for walls spanning laterally between two supports, nor 4 for cantilever walls and parapets; and,
3. The wall is of sufficient strength to resist the required earthquake forces from 780 CMR 1612.7.

Masonry walls allowed to be unreinforced by the provisions of the code for new construction and which satisfy all provisions of the code for new construction need not satisfy 780 CMR 3408.6.4 item 2. Additional bracing or structural ties may be provided to meet these requirements. Unreinforced walls continuing in service under 780 CMR 3408.6.4 shall not be considered effective as shear walls resisting lateral earthquake force specified in 780 CMR 16, except where the provisions of 780 CMR 3408.0 specifically permit use of structural systems not conforming to 780 CMR 2104.

3408.6.5 Changes in Building Mass: A reduction in the weight of a building shall not be considered to offset a reduction in lateral load capacity of the building, in evaluating compliance with 780 CMR 3408.3.5, except that the weight of the building as altered shall be used in evaluating compliance with 780 CMR 1612.0. An increase in the weight of the building shall be considered as an addition, for purposes of determining earthquake resistance requirements (see 780 CMR 3408.4).

3408.7 Liquefaction Evaluation for Existing Buildings: The subsoils supporting the existing building shall be evaluated to determine the potential for liquefaction, and if necessary the subsoils and/or foundations shall be improved to prevent failure in the event liquefaction occurs, as required below:

1. Existing buildings *with Seismic Hazard Category* 1 (see 780 CMR 3408.5.4 and Table 3408.1) shall not require evaluation of liquefaction potential or compliance with 780 CMR 1805.3.
2. Existing buildings with *Seismic Hazard Category* 2 or 3 (see 780 CMR 3408.5.4 and Table 3408.1) shall comply with the requirements of 780 CMR 1805.3.
3. Existing buildings with structurally separate additions shall comply with 3408.7 item 1 or 2, based on the *Seismic Hazard Category* of the existing building.
4. Existing buildings with structurally attached additions which meet the requirements of 780 CMR 3408.4.3.2, item 1, and which are

classified as *Seismic Hazard Category* 1 (see 780 CMR 3408.5.4 and Table 3408.1), shall not require evaluation of liquefaction potential or compliance with 780 CMR 1805.3.

5. Existing buildings with structurally attached additions which meet the requirements of 780 CMR 3408.4.3.2, item 2, and which are classified as *Seismic Hazard Category* 1 or 2, shall comply with the requirements of 780 CMR 1805.3, except that the blow count scale in Figure 1805.3 may be multiplied by the appropriate reduction factor from Figure 3408.1.

6. Existing buildings with structurally attached additions which meet the requirements of 780 CMR 3408.4.3.2, item 3, shall comply with the requirements of 780 CMR 1805.3.

780 CMR 3409.0 *HISTORIC BUILDINGS*

3409.1 Scope: The provisions of 780 CMR 3409.0 shall govern all buildings and structures in the Commonwealth which are legally designated as *historic buildings*. 780 CMR 3409.0 shall preempt all other regulations of 780 CMR governing the reconstruction alterations change of use and occupancy, repairs maintenance and additions for the conformity of historic buildings and structures to 780 CMR, with the exception of 780 CMR 122.0 for appeals, or unless otherwise specified (see *Appendix H*). There is no obligation for owners of historic properties to apply for 780 CMR 3409.0.

3409.1.1 Key Definitions: The following five definitions are found in 780 CMR 3401.1, but are also presented here as such definitions form a significant portion of 780 CMR 3409.

Historic buildings: (a) Any building or structure individually listed on the National Register of Historic Places or (b) any building or structure evaluated by MHC to be a contributing building within a National Register or State Register District. (c) any building or structure which has been certified by the Massachusetts Historical Commission to meet eligibility requirements for individual listing on the National Register of Historic Places. *Historic building* shall be further defined as *totally* or *partially preserved buildings*. All entries into the *totally preserved building* list shall be certified by the Massachusetts Historical Commission. The Board of Building Regulations and Standards shall ratify all buildings or structures certified by the Massachusetts Historical Commission to qualify for *totally preserved* listing (see Appendix H).

Partially preserved buildings: (a) Any building or structure individually listed on the National Register of Historic Places or (b) any building or structure certified as a *historic building* by the Massachusetts Historical (Commission/t and not designated a *totally preserved building* in *Appendix H.*

Restoration: *Restoration* is the process of accurately reconstructing or repairing the forms and details of a building or structure or portion thereof as it appeared at a particular period or periods of time by means of removal of later work/or the replacement of missing original work

Totally preserved buildings: A *totally preserved building* is an *historic building* or structure. The principal use of such a building or structure must be as an exhibit of the building or the structure itself which is open to the public not less than 12 days per year, although additional uses, original and/ or ancillary to the principal use shall be permitted within the same building up to maximum of 40% of the gross floor area. *Totally preserved buildings* shall be those listed in *Appendix H.* All entries into the *totally preserved building* list shall be certified by the Massachusetts Historical Commission. The Board of Building Regulations and Standards shall ratify all buildings or structures certified by the Massachusetts Historical Commission to qualify for *totally preserved* listing (See *Appendix H*).

3409.2 ***Totally preserved buildings***:

3409.2.1 State Building Code exceptions: A *totally preserved building* shall be subject to the following exceptions:

1. Repairs, maintenance and restoration shall be allowed without conformity to 780 CMR generally, if the provisions of 780 CMR 3409.2.2 have been met.
2. In case of fire or other casualty to a *totally preserved building*, said building may be rebuilt, in total or in part, using such techniques and materials as are necessary to restore it to its original condition and use group.
3. If a *historic building* or structure, as a result of proposed work, would become eligible for certification as a *totally preserved building* and the Massachusetts Historical Commission so certifies by affidavit, such affidadit is submitted to the building official with the permit application, and the building official shall then allow the work to proceed under the provisions of 780 CMR 3409.2.

3409.2.2 Mandatory safety requirements: All *totally preserved buildings* shall comply to the following requirements:

3409.2.2.1 Fire protection equipment: Fire protection equipment shall be provided according to the following requirements.

1. Manual fire extinguishing equipment: All use groups, other than Residential R-3 and R-4, shall have approved manual fire extinguishing equipment, as determined by the head of the local fire department.

2. Fire Protective Signaling Systems (Fire Alarm Systems): All residential buildings in use groups R-1, R-2 and R-3 shall conform to the applicable requirements of 780 CMR 918 and 919 as applicable. All other use groups shall comply with 780 CMR 3409.2.2.1 items 2.(a) and (b):

(a) **Locations**: Provide smoke detectors in accordance with manufacturers listing and spacing requirements, but not less than one, for every 1200 square feet of floor area per level. In addition, all lobbies, common corridors, hallways and exitway access and discharge routes shall be provided with approved smoke detectors installed in accordance with the manufacturers listing and spacing requirements but not more than 30 feet spacing between detectors. All required smoke detectors shall have an alarm audible throughout the structure or building.

(b) **Single station and multiple station smoke detection devices**: Smoke detectors of single station and multiple station types shall meet the requirements of UL 217 and be listed or approved by a nationally-recognized fire-testing laboratory. All other smoke detectors shall be listed in accordance with UL 268 as listed in ***Appendix A***.

3. **Manual pull stations:** A manual fire alarm pull station shall be provided in the natural path of egress in all use groups except R-3 and R-4. Manual pull stations shall be connected to the building fire warning system in conformance with NFPA 72 as listed in ***Appendix A***.

3409.2.2.1.1 Supervision: Fire protective signaling systems required by 780 CMR 3409.2.2.1 shall be supervised in accordance with the requirements of 780 CMR 923.2.

Exception: Residential single and multiple station smoke detectors.

3409.2.2.2 Exit signs and emergency lights: Approved exit signs and emergency lighting, where designated by the local building official, shall be provided in compliance with 780 CMR 1023.0 and 780 CMR 1024.0.

Exception: All *totally preserved buildings* need not comply with 780 CMR 1023.0 and 780 CMR 1024.0 if not occupied after daylight hours, except that paths of egress shall have exit signs.

3409.2.2.3 Maximum occupancy: Occupancy shall be limited by the actual structural floor load capacity as certified by a qualified Massachusetts *registered professional engineer* or *architect* or in accordance with 780 CMR 1008.0, whichever is less. Said floor load shall be posted in accordance with the procedures set forth in 780 CMR 120.0, 780 CMR 1003.3 and 780 CMR 1617.2. The owner shall submit evidence of this certification and related computations to the building official upon request.

3409.2.2.4 Limited egress: Where one or more floors of a *totally preserved building* are limited to one *means of egress*, the occupancy load shall be computed as follows:

1. **Floors below the first story**: Not more than one occupant per 100 square feet of gross floor area with a maximum occupancy of 49.
2. **First story**: Not more than one occupant per 50 square feet of gross floor area.
3. **Second story and above**: Not more than one occupant per 100 square feet of gross floor a area, or 30 occupants per unit of egress width, whichever condition results in the lesser occupancy load.

3409.2.2.5 Inspections: The *building official* and the fire official shall inspect all totally preserved buildings not less frequently than once every year in order to determine that the building or structure continues to conform to 780 CMR 3409.2. A qualified Massachusetts *registered professional engineer* or *architect* shall certify every five years thereafter as to the exact floor load capacity of the building or structure. The building official shall certify all totally preserved buildings not less frequently than once every year. Fees shall be established at $25.00 per building per inspection.

3409.2.2.6 Accessibility for Persons with Disabilities: Accessibility requirements shall be in accordance with 521 CMR as listed in ***Appendix A***.

3409.2.2.7 Energy Conservation: Totally preserved buildings are exempt from the requirements of 780 CMR 13 and the energy conservation rewuirements of 780 CMR 36.

3409.3 ***Partially preserved buildings***:

3409.3.1 State Building Code provisions: A *partially preserved building* shall be subject to the following provisions:

1. **Existing Systems** - individual components of an existing *building system* may be repaired or replaced in kind without requiring that system to comply fully with the code for new construction. (See 780 CMR 34, 780 CMR 3404.3: *New Systems)*
2. **Replacement in kind** - when the repair of historic materials including patching, splicing, piecing-in, consolidating or reinforcing is not possible, compatible materials may be substituted which closely convey the form and design as well as the visual appearance of the existing feature.

3409.3.2 State Building Code exceptions: A *partially preserved building* shall be subject to the following exceptions: Repairs or in kind replacement of the following features will be allowed on partially preserved buildings so as not to compromise the architectural integrity of the historical characteristics and qualities which contributed to the eligibility for listing in the National Register of Historic Places.

1. **Roofing** - repair or in kind replacement of an existing historic roof system (i.e., slate, wood, clay, tile, metal) shall be permitted without requiring structural compliance for equivalent new construction providing that dead and live loading requirements have not changed.
2. **Windows** - repair or in kind replacement of existing historic windows (i.e., frames, sash, muntins, glazing, sills, molding, shutters) shall be permitted without requiring energy code compliance.
3. **Entries/Porches** - repair or in kind replacement of existing individual decorative features of an existing system (i.e. columns, balustrades, stairs, pilasters, doors, sidelights) shall be permitted.
4. **Wood Siding/Decorative Elements** - Repair or in kind replacement of an existing system including such items as clapboards, shingles, cornices, brackets, and window and door surrounds shall be permitted.
5. **Masonry** - repair or in kind replacement of masonry units as part of an existing system (i.e., brick, stone, terra cotta, concrete and stucco) shall be permitted.
6. **Metals** - repair or in kind replacement of existing architectural metals (i.e. cast and wrought iron, steel, tin, copper and copper alloys, aluminum, zinc) shall be permitted.
7. **Interior features** - repair or in kind replacement of non-structural interior features that are important in defining the overall historic character of a building (i.e., columns, cornices, baseboards, fireplace mantels, paneling, window trim, doors, moldings, railings, flooring, plasterwork) shall be permitted.

3409.3.3 Applicability: 780 CMR 3409.3 and 780 CMR 34 shall apply to all *partially preserved Historic buildings*.

3409.3.4 Continuation of use and occupancy: The legal use and occupancy of any partially preserved building may be continued without change or further compliance to 780 CMR. The provisions of 780 CMR 3409.2 shall be required for *Historic buildings* accessible to the public on more than 50 days per year.

3409.3.5 Inspection certification and fees: *Partially preserved buildings* shall not require annual inspection unless otherwise stipulated in 780 CMR 106.5 and Table 106.

3409.3.6 Fire damage: If a building or structure is damaged from fire or other casualty it may be restored to its original construction or it shall meet the requirements of 780 CMR provided these requirements do not compromise the features for which the building was considered Historic when listed in the National Register of Historic Places.

3409.3.7 Change in occupancy: See 780 CMR 34.

3409.3.8 *New systems*: See 780 CMR 34.

3409.3.9 Lesser and equal hazard: See 780 CMR 34. A *partially preserved building* classified under unprotected construction Type 3C or 5B shall have waived the requirement to add one to the Hazard Index number (See 780 CMR 34, Table 3403).

3409.3.10 Greater hazard: See 780 CMR 34. A *partially preserved building* classified under unprotected construction Type 3C or 5B shall have waived the requirement to add one to the Hazard Index number (See 780 CMR 34, Table 3403).

3409.3.11 Energy Conservation: Partially preserved buildings are exempt from the energy requirements of 780 CMR 13 and the energy requirements of 780 CMR 36.

> **Exception:** Additions to partially preserved buildings shall comply with the energy provisions of 780 CMR 13 or of 780 CMR 36, as applicable.

3409.3.12 Accessibility for Persons with Disabilities: Accessibility requirements shall be in accordance with 521 CMR as listed in ***Appendix A***.

CHAPTER 35

MANUFACTURED BUILDINGS, MANUFACTURED BUILDING COMPONENTS AND MANUFACTURED HOUSING

(This Chapter is entirely unique to Massachusetts)

780 CMR 3501.0 GENERAL

3501.1 Scope: The provisions of 780 CMR 35 shall govern the materials, design, manufacture, handling, storage, transportation, assembly, construction and/or installation of *manufactured buildings* and *manufactured building components* intended for installation in the Commonwealth of Massachusetts. *Manufactured buildings or manufactured building components* shall not be installed in any jurisdiction of the Commonwealth of Massachusetts unless such *manufactured buildings* or *manufactured building components* have been approved and certified in accordance with 780 CMR 35, applicable provisions of 780 CMR, and the Rules and Regulations for *Manufactured Buildings, Manufactured Building Components and Manufactured Housing*, 780 CMR R3, as listed in ***Appendix A***.

3501.2 Manufactured housing: When constructed in accordance with the Code of Federal Regulations (CFR) Title 24, Chapter XX - Office of Assistant Secretary for Housing - Federal Housing Commissioner, Department of Housing and Urban Development, Parts 3280, Manufactured home construction and safety standards, and 3282, Manufactured home procedural and enforcement regulations; manufactured housing shall be exempt from the provisions of 780 CMR 35.

Exceptions:

1. Foundations for *manufactured housing* shall conform to 780 CMR 1806 through 1813, or 780 CMR 3604 as applicable;
2. Additions, (when not a *manufactured home* as defined herein) and site built modifications shall conform to 780 CMR in its entirety, as applicable.

780 CMR 3502.0 DEFINITIONS

3502.1 General: The following words and terms shall, for the purposes of 780 CMR 35 and as used elsewhere in 780 CMR, shall have the meaning shown herein.

Approved: Approval by the State Board of Building Regulations and Standards (BBRS).

Manufactured Building Component: Any manufactured subsystem, manufactured subassembly, or other manufactured system designed for use in or part of a structure having concealed elements such as electrical, mechanical, plumbing and fire protection systems and other systems affecting health and safety, including variations which are submitted as part of the building systems.

Certification: Any manufactured building, manufactured building component or *manufactured housing* which meets the provisions of applicable codes and 780 CMR R3 pursuant thereto, as listed in ***Appendix A***; which has been labeled accordingly.

Code: 780 CMR (The Commonwealth of Massachusetts State Building Code) or specialized codes as defined herein, and as listed in ***Appendix A***.

Department (DPS): The Department of Public Safety, Division of Inspections.

Inspection Agency: An independent agency, sometimes referred to as the "third-party agency", retained by the manufacturer and approved by the BBRS to perform inspections and evaluations of manufactured building systems, compliance assurance programs, manufactured buildings and manufactured building components.

Installation: The process of affixing, or assembling and affixing a manufactured building, manufactured building component or manufactured housing unit(s) on the building site, and connecting it to utilities, and/or to an existing building. Installation may also mean the connecting of two or more manufactured housing units designed and approved to be so connected for use as a dwelling.

Installer of Manufactured Building: An individual, who on the basis of training and experience, has been certified by a specific manufacturer of manufactured homes as competent to supervise the placement and connection required to install the manufactured homes of that manufacturer. Said certification by the manufacturer shall be in writing; additionally, the certified installer shall possess picture identification in the form of a driver's license or other picture identification acceptable to the building official.

Label: An approved device or seal evidencing certification in accordance with the applicable codes and rules and regulations promulgated pursuant thereto, and as listed in ***Appendix A***.

Local Enforcement Agency: A department or agency in a municipality charged with the enforcement of 780 CMR and appropriate specialized codes which include, but are not limited to, 248 CMR (the State Fuel Gas and Plumbing Code) and 527 CMR 12.00 (the State Electrical Code), as listed in *Appendix A*.

Manufactured Building: Any manufactured building which has concealed elements, such as electrical, mechanical, plumbing, fire protection, insulation, and other systems affecting health and safety, and which is manufactured or assembled in accordance with 780 CMR and pertinent regulations, in manufacturing facilities, on or off the building site. Also, any manufactured building as defined above which does not have concealed elements, but which has been approved by the BBRS at the request of the manufacturer. "Manufactured building" does not mean "manufactured home".

Manufactured Homes (Housing): As defined in 24 CFR, Part 3280.2; a structure, transportable in one or more sections, which in the traveling mode, is eight body feet or more in width or forty body feet or more in length, or, when erected on site, is 320 or more square feet, and which is built on a permanent chassis and designed to be used as a dwelling with or without a permanent foundation when connected to the required utilities, and includes the plumbing, heating, air-conditioning, and electrical systems contained therein. Calculations used to determine the number of square feet in a structure will be based on the structure's exterior dimensions measured at the largest horizontal projections when erected on site. These dimensions will include all expandable rooms, cabinets, and other projections containing interior space, but do not include bay windows. (See 24 CFR, Part 3280.2 for a more detailed description of manufactured homes as defined by the Department of Housing and Urban Development.)

Specialized Code: All building codes, rules or regulations pertaining to building construction, reconstruction, alteration, repair, or demolition promulgated by and under the authority of the various agencies which have been authorized from time to time by the General Court of the Commonwealth of Massachusetts. The specialized codes shall include, but are not limited to, 248 CMR (the State Fuel Gas and Plumbing Code) and 527 CMR 12.00 (the Electrical Code), as listed in *Appendix A*.

780 CMR 3503.0 CONSTRUCTION DOCUMENTS

3503.1 Building System Plans: The building system plans shall show in sufficient detail the approved system to which the manufactured building or building component was produced; including foundation connection details, component connection details, emergency escape window locations and sizes, structural design loads, the manufacturer's data plate, the location of all labels required of 780 CMR 35 and 780 CMR R3, and other details as may be required by the Division of Inspection. The building system plan shall bear evidence of the approval of the Division of Inspection and evidence of third party engineering review.

780 CMR 3504.0 APPROVAL

3504.1 General: The Commonwealth of Massachusetts, Department of Public Safety, Division of Inspection (hereinafter referred to as the "Division of Inspection" in 780 CMR 35) shall evaluate manufactured buildings and building components and recommend approval to the BBRS of those which it determines to be in compliance with applicable sections of 780 CMR 35, other applicable sections of 780 CMR, and 780 CMR R3, as listed in *Appendix A*.

All approvals of plumbing, electrical or gas systems shall be made by the appropriate state agencies having jurisdiction, as specified in 780 CMR R3, as listed in *Appendix A*.

3504.2 Approved tests: The Division of Inspection may utilize the results of approved tests to determine whether a manufactured building or manufactured building component meets the requirements of this chapter and the 780 CMR R3 as listed in *Appendix A*, if that determination cannot be made from evaluation of plans, specifications and documentation alone.

3504.3 Approval of compliance assurance programs: The Division of Inspection shall evaluate manufacturers' compliance assurance programs and make recommendations for approval to the BBRS of those which it determines to be in compliance with this chapter and 780 CMR R3, listed in *Appendix A*.

3504.4 Authorization to vary: A manufactured building, manufactured building component or a compliance assurance program heretofore approved in accordance with 780 CMR 3503.3, shall not be varied in any way without prior authorization by the BBRS in accordance with 780 CMR R3, as in *Appendix A*.

780 CMR 3505.0 CERTIFICATION

3505.1 Labeling: Any *manufactured building* or *manufactured building component* heretofore approved, in accordance with 780 CMR 3504.0, shall have an approved device or seal affixed as certification of such approval.

780 CMR 3506.0 RECIPROCITY

3506.1 General: If the BBRS finds that the standards for manufacture and inspection of *manufactured buildings* or *manufactured building components* prescribed by the statutes or the rules and regulations of another state or other governmental agency meet the objectives of 780 CMR 35 and 780 CMR R3, listed in ***Appendix A***, and such standards are enforced satisfactorily by such other state or governmental agency or by its agents, the BBRS may grant approval and the Division of Inspection shall accept all *manufactured buildings* or *manufactured building components* which have been approved in accordance with this section by such other state or governmental agency and shall insure that the product is properly labeled.

3506.1.1 Condition of reciprocity: The standards of another state shall not be deemed to be satisfactorily enforced unless such other state provides for notification to the BBRS of suspensions or revocations of approvals issued by that state, in a manner satisfactory to the BBRS.

3506.2 Suspension of reciprocal approval: Upon recommendation from the Division of Inspection, the BBRS shall suspend or cause to be suspended reciprocal approval for the following reasons:

1. Determination that the standards for the manufacture and inspection of such *manufactured buildings* or *manufactured building components* of another state or other governmental agency do not meet the objectives of 780 CMR 35 and 780 CMR R3, listed in ***Appendix A***, or that the standards are not being enforced to the satisfaction of the Division of Inspection or BBRS; and
2. if another state or governmental agency, or its agent, suspends or revokes said approval, the approval granted under 780 CMR 3506.2 shall be suspended or revoked accordingly.

780 CMR 3507.0 ASSURANCE INSPECTION

3507.1 General: Any person or firm producing *manufactured buildings* or *manufactured building components* applying for certification shall agree in writing that the Division of Inspection or the BBRS has the right to conduct unannounced inspections at any reasonable time.

3507.2 Responsibilities of Division of Inspection: The Division of Inspection shall carry out the following responsibilities:

1. Periodically make, or cause to be made, inspections of the entire process of the production of *manufactured buildings* or *manufactured building components* in order to verify the reliability of the compliance assurance program and of the approved *inspection agency*.
2. In addition to other on-site inspection provided for in 780 CMR 3507.2, the Division of Inspection shall inspect, or cause to be inspected, certified manufactured buildings or manufactured building components which it determines to have been sufficiently damaged after certification to warrant such action with regard to such manufactured buildings or manufactured building components as is authorized hereof, or as is otherwise necessary to eliminate dangerous conditions.

Note: An inspection entailing disassembly, damage to or destruction of certified *manufactured buildings* or *manufactured building components* shall not be conducted except to implement the provisions of 780 CMR 35.

780 CMR 3508.0 RESPONSIBILITY OF THE LOCAL ENFORCEMENT AGENCIES

3508.1 Issuance of building permits: Upon application and in conformity with the provisions of 780 CMR, the building official shall issue building permits for installation of certified *manufactured buildings, manufactured building components* or manufactured housing.

3508.1.1 Licensed Construction Supervisors and Certified Installers: A construction supervisor, duly licensed in accordance with 780 CMR R5, shall, in accordance with 780 CMR 108.3.5, act as the agent for the owner for the purpose of applying for and obtaining any and all building permits required for the field erection of all one or two family manufactured dwellings subject to the provisions of 780 CMR 35 and applicable 780 CMR R3.

As part of the building permit application process, the licensed construction supervisor shall submit to the building official, in writing, the name of the installer, who shall be duly certified by the manufacturer to install said manufacturer's product, and is identified as a *certified installer of manufactured buildings* (certified installer) by said manufacturer. The certified installer shall be responsible for the safe and proper placement and connection of the manufactured home units in accordance with 780 CMR 35, 780 CMR R3 and specialized codes as listed in ***Appendix A***.

The licensed construction supervisor shall be responsible for the construction of the foundation system, and all pertinent site work, in accordance with 780 CMR 35 and 780 CMR R3 listed in *Appendix A*. The licensed construction supervisor shall provide at least 48 hours notice to the building official before the placement and connection of such units shall begin.

3508.2 Inspection: The local enforcement agency shall make the following inspections:

1. The site preparation work, including foundations, installation of any certified *manufactured buildings* or *manufactured building components* or approved homes; and for all utility service connections, including plumbing, electrical, gas, water and sewer; for compliance with the applicable codes.
2. Inspect all certified *manufactured buildings* or *manufactured building components* or approved *manufactured homes* upon, or promptly after, installation at the building sites to determine whether all applicable instructions or conditions have been followed. This may include tests for tightness of plumbing and mechanical systems, for malfunctions in the electrical system, and a visual inspection for obvious violations of 780 CMR R3. Destructive disassembly of certified *manufactured buildings* or *manufactured building components* or approved *manufactured homes* shall not be performed in order to conduct such inspections. Nondestructive disassembly may be performed only in accordance with 780 CMR R3.

> **Note**: Notification to the BBRS. When any local enforcement agency finds a violation or suspects a violation exists, said violation or suspected violation shall be reported to the BBRS in accordance with 780 CMR R3.5.6.

3508.3 Issuance of certificates of occupancy: The building official shall issue a certificate of occupancy for all certified *manufactured buildings* or approved *manufactured homes* that have been installed and inspected and that meet the requirements of 780 CMR.

780 CMR 3509.0 SUSPENSION OR REVOCATION OF CERTIFICATION

3509.1 General: The Board shall suspend or revoke the approval of any *manufactured building* or *manufactured building component* which does not comply with the provisions of 780 CMR or with 780 CMR R3.

3509.2 *Labels* of certification: The Division of Inspection shall remove or cause to be removed the *label* of certification from any such *manufactured building or building component* not in compliance until such time as it is brought into compliance with 780 CMR 35 and 780 CMR R3.

3509.3 Notice of suspension or revocation: Notice shall be submitted in writing to the affected parties stating the reason for the suspension or revocation.

3509.4 Appeals Procedure: All appeals from suspension or revocation shall be heard by the State Building Code Appeals Board as specified in the pertinent provisions of 780 CMR 122.0.

ONE AND TWO FAMILY DWELLING CODE

(This Section is unique to Massachusetts.)

780 CMR 3601.0 GENERAL ADMINISTRATION

3601.1 General: The provisions of *780 CMR 36* shall be known as the One and Two Family Dwelling Code, ***and*** may be cited as such.

3601.1.1 Application of other laws: Nothing herein contained shall be deemed to nullify any provisions of the zoning by-laws or ordinance of any municipality in the Commonwealth of Massachusetts insofar as those provisions deal exclusively with those powers of regulating zoning granted by the provisions of M.G.L. c.40A and 41.

780 CMR 3601.2 PURPOSE

3601.2.1 Minimum standards: The purpose of 780 CMR 36 is to provide minimum standards for the protection of life, limb, health, property, environment and for the safety and welfare of the consumer, general public, and the owners and occupants of residential buildings regulated by 780 CMR 36.

3601.2.2 Scope: 780 CMR 1, in its entirety, shall serve as the administrative requirements of 780 CMR 36.

NON-TEXT PAGE

780 CMR 3602

BUILDING DEFINITIONS

780 CMR 3602.0 GENERAL

3602.1 Scope: *Unless otherwise expressly stated, the following words and terms shall, for the purposes of 780 CMR 36, have the meaning shown herein.* Words used in the singular include the plural, and the plural the singular. Words used in the masculine gender include the feminine, and the feminine the masculine.

3602.1.1 Terms defined in other codes: Where terms are not defined in 780 CMR 36, but are defined in the plumbing, fire prevention, or mechanical codes, or other elsewhere in 780 CMR, or its reference standards as listed in Appendix A, such terms shall have the meanings ascribed to them in those codes.

3602.1.2 Terms not defined: Where terms are not defined through the methods authorized by 780 CMR 3602.1.1, such terms shall have the ordinarily accepted meanings such as the context implies.

780 CMR 3602.2
GENERAL BUILDING DEFINITIONS

ACCESSORY STRUCTURE: A building, the use of which is incidental to that of the main building and which is located on the same lot.

ACCESSORY USE: A use incidental to the principal use of a building as defined or limited by the provisions of the local zoning laws.

APPROVED: Approved *by the Board of Building Regulations and Standards (BBRS),* the building official, or by reason of accepted principles or tests by nationally recognized organizations*, or by accepted engineering practice.*

APPROVED AGENCY: An established and recognized agency regularly engaged in conducting tests or furnishing inspection services, when such agency has been approved *as defined herein*.

BALCONY (Exterior): An exterior floor system projecting from a structure and supported by that structure, with no additional independent supports.

BASEMENT: That portion of a building which is partly or completely below grade (see "Story above grade").

BOARD OF BUILDING REGULATIONS AND STANDARDS (BBRS): In accordance with M.G.L. c. 143, § 94, the Board responsible for the development and promulgation of 780 CMR (the Massachusetts State Building Code). See M.G.L. c. 143, §§ 95 through 100 for additional responsibilities of the BBRS.

BUILDING: Building shall mean any one- and two-family dwelling or portion thereof, which is used, or designed or intended to be used for human habitation, for living, sleeping, cooking or eating purposes, or any combination thereof, and shall include structures accessory thereto.

BUILDING, EXISTING: A building erected prior to the adoption of this code, or one for which a legal building permit has been issued.

BUILDING OFFICIAL: *See building code enforcement official 780 CMR 2.*

CEILING HEIGHT: Ceiling height shall be the clear vertical distance from the finished floor to the finished ceiling.

DECK: An exterior floor system supported on at least two opposing sides by an adjoining structure and/or posts, piers, or other independent supports.

DWELLING, ONE FAMILY: A building containing one dwelling unit with not more than five lodgers and boarders.

DWELLING, TWO FAMILY: A building containing two dwelling units with not more than five lodgers or boarders per family.

DWELLING UNIT: A single unit providing complete independent living facilities for one or more persons including permanent provisions for living, sleeping, eating, cooking and sanitation.

FOUNDATION: A base constructed to support any building or structure including but not limited to footings, floating foundation, piles and caissons.

FOUNDATION WALL: A wall below the floor nearest grade serving as a support for a wall, pier, column or other structural part of a building.

GRADE: ***A reference plane representing*** the ***average*** finished ground level adjoining the building at all exterior walls.

GRADE FLOOR WINDOW: A window located such that the sill height of the window is not more than 44 inches (1118 mm) above or below the finished grade adjacent to the window.

GREENHOUSE: An enclosed detached or attached accessory structure consisting primarily of light-transmitting materials and used exclusively for growing plants. ***In accordance with St. 1973, c. 672, the provisions of the 780 CMR shall not apply to greenhouses covered exclusively with plastic film; provided, however, that the provisions of M.G.L. c. 40A shall continue to apply.***

GUARDRAIL SYSTEM: A system of building components located near open sides of elevated walking surfaces.

HABITABLE ROOM (SPACE): Habitable room shall mean any room meeting the requirements of 780 CMR 36 for sleeping, living, cooking or dining purposes, excluding such enclosed places as closets, pantries, bath or toilet rooms, hallways, laundries, storage spaces, utility rooms and similar spaces.

HANDRAIL: A horizontal or sloping rail grasped for guidance or support.

KITCHEN: Kitchen shall mean an area used, or designated to be used for the preparation of food.

LISTED and LISTING: Terms referring to equipment which is shown in a list published by an approved testing agency qualified and equipped for experimental testing and maintaining an adequate periodic inspection of current productions and whose listing states that the equipment complies with nationally recognized standards, when installed in accordance with the manufacturer's installation instructions.

LOADS, LIVE AND DEAD: ***See 780 CMR 2.***

MANUFACTURED HOME: ***See 780 CMR 35 and 780 CMR-R3.***

MUNICIPALITY: Any city or town in the Commonwealth of Massachusetts. The word "municipality" shall be construed, where the context requires, as though followed by the words "or combination of municipalities".

OCCUPIED SPACE: ***See 780 CMR 2.***

REPAIRS, ORDINARY: See 780 CMR 2.

SPAN, CLEAR: For simple, continuous and cantilevered bending members, the span shall be taken as the distance from face to face of supports, plus ½ the required bearing length at each end.

STORY: Story is that portion of a building included between the upper surface of any floor and the upper surface of the floor next above, except that the topmost story shall be that habitable portion of a building included between the upper surface of the topmost floor and ceiling or roof above.

STORY ABOVE GRADE: Any story having its finished floor surface entirely above grade except that a basement shall be considered as a story above grade when the finished surface of the floor above the basement is:

1. More than six feet (1829 mm) above grade plane;
2. More than six feet (1829 mm) above the finished ground level for more than 50 percent of the total building perimeter; or
3. More than 12 feet (3658 mm) above the finished ground level at any point.

WALL: See 780 CMR 2.

WINDOW: Window shall mean a glazed opening, including portions of glazed doors.

WOOD STRUCTURAL PANEL: A structural panel product composed primarily of wood, and meeting the requirements of DOC PS 1 or DOC PS 2. Wood structural panels include all veneer plywood, composite panels containing a combination of veneer and wood-based material, and mat-formed panels such as oriented strand board and waferboard.

780 CMR 3603

BUILDING PLANNING

(*This Section is unique to Massachusetts.*)

780 CMR 3603.1 STRUCTURAL DESIGN CRITERIA

3603.1.1 Design: Buildings and structures, and all parts thereof, regulated by 780 CMR 36, shall be constructed to support safely all applied dead, live and environmental loads specified in 780 CMR 3603.1.

> **Exception**: One and Two Family Dwellings are exempt from the earthquake load requirements of 780 CMR 1612.

3603.1.2 Dead load: The actual weights of materials and construction shall be used for determining dead load with consideration for the dead load of fixed service equipment.

3603.1.3 Live load: The minimum uniformly distributed live load shall be as specified in Table 3603.1.3. Elevated garage floors shall be designed to support a 2,000 pound (8.90 kN) concentrated load applied over a 20 square inch ($0.0129\ m^2$) area, in addition to the loads specified in table 3603.1.3.

3603.1.4 Roof Live Load: Roofs shall be designed to support the live load specified in Table 3603.1.4, or the snow load specified in 780 CMR 3603.1.5, whichever is greater.

3603.1.5 Basic snow load: Figures 3603.1.5a, 3603.1.5b, 3603.1.5c and 3603.1.5d define four snow load zones. The basic snow load for each zone shall be applied to the horizontal projection of sloped or flat roofs and unenclosed floor areas, as a uniformly distributed load, P_f, in pounds per square foot, as specified in Table 3603.1.5.

3603.1.6 Deflection: The allowable deflection of any structural member under the live load or snow load listed in 780 CMR 3603.1.3, 3603.1.4 and 3603.1.5 shall not exceed the values in Table 3603.1.6.

Table 3603.1.3
MINIMUM UNIFORMLY DISTRIBUTED LIVE LOADS (POUNDS PER SQUARE FOOT)

USE	LIVE LOAD (psf)
Balconies and decks	60
Garages (passenger cars only)	50 (1)
Attics (roof slope not steeper than 3 in 12 - no storage)	10
Attics (limited storage)	20
Living Areas (except sleeping rooms)	40
Sleeping Rooms	30
Stairs	40 (2)
Guardrails and Handrails (single concentrated load at any point along the top)	200

Notes:

(1) See also 780 CMR 3603.1.3

(2) In addition to the uniformly distributed live load, individual stair treads shall be designed for a single concentrated load of 300 pounds over an area of four square inches.

Table 3603.1.4
MINIMUM ROOF LIVE LOAD (POUNDS PER SQUARE FOOT OF HORIZONTAL PROJECTION)

ROOF SLOPE	TRIBUTARY LOADED AREA (square feet) for any structural member		
	0 to 200 sf	201sf to 600 sf	Over 600 sf
Flat, or rise less than 4 inches per foot	20	16	12
Rise 4 inches per foot to less than 12 inches per foot	16	14	12
Rise 12 inches per foot or greater	12	12	12

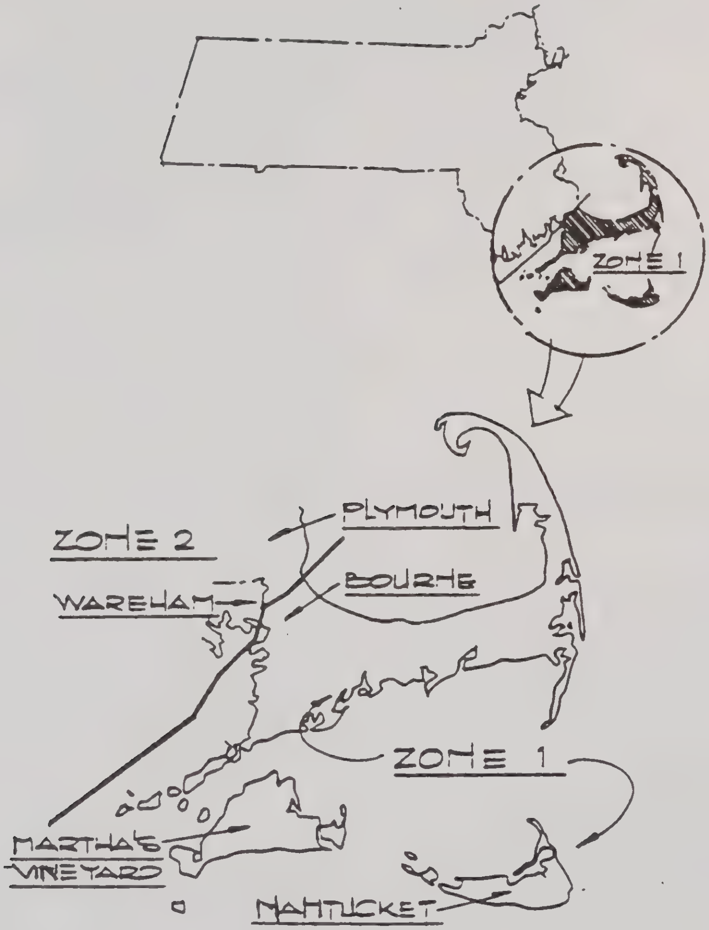
Table 3603.1.5
BASIC SNOW LOAD, P_f

SNOW LOAD ZONE[1]	BASIC SNOW LOAD P_f
1	25 psf
2	30 psf
3	35 psf
4	40 psf

Notes:

1. See figures 3603.1.5 a through d

Figure 3603.1.5a
MINIMUM UNIFORM SNOW LOAD MAP
ZONE 1


ZONE 1
PLYMOUTH
ZONE 2
WAREHAM
BOURNE
ZONE 1
MARTHA'S VINEYARD
NANTUCKET

List of Towns in Minimum Uniform
Snow Load Zones Zone 1

Barnstable
Bourne
Brewster

Chatham
Chilmark

Dennis

Eastham
Edgartown

Falmouth

Gay Head
Gosnold

Harwich

Mashpee

Nantucket

Oak Bluffs
Orleans

Provincetown

Sandwich

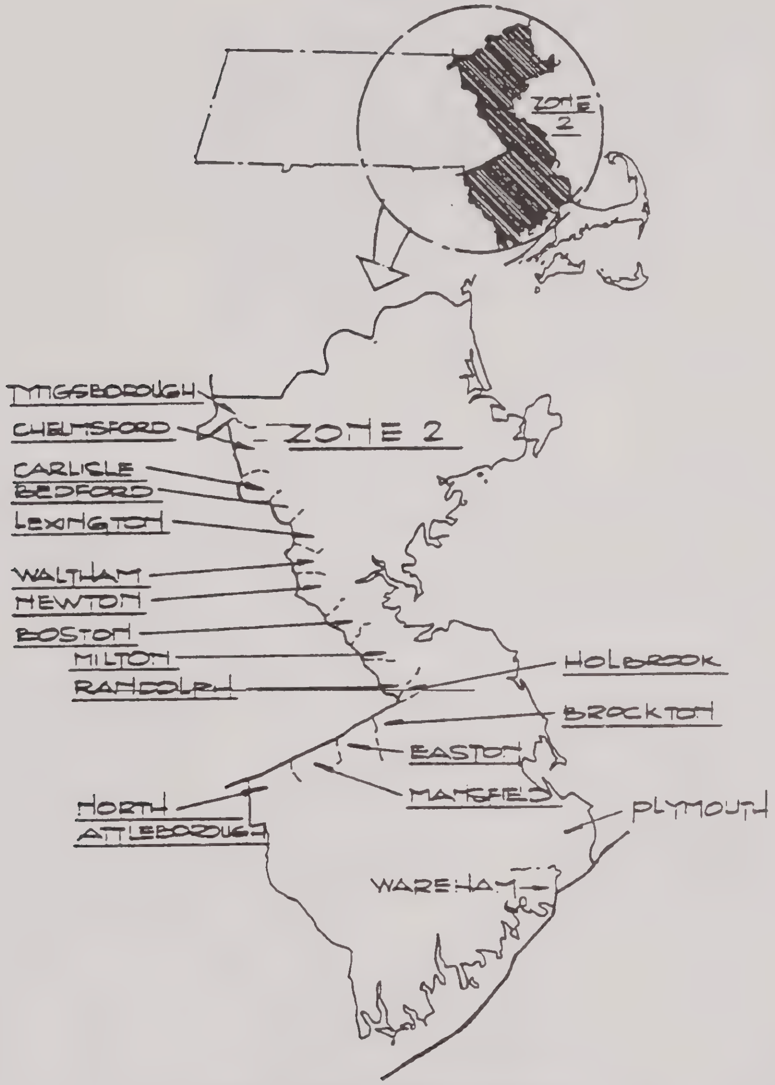
Tisbury
Truro

Vineyard Haven

Wellfleet
West Tisbury

Yarmouth

Figure 3603.1.5b
MINIMUM UNIFORM SNOW LOAD MAP
ZONE 2


ZONE 2
TYNGSBOROUGH
CHELMSFORD
ZONE 2
CARLISLE
BEDFORD
LEXINGTON
WALTHAM
NEWTON
BOSTON
MILTON
RANDOLPH
HOLBROOK
BROCKTON
EASTON
MANSFIELD
NORTH
ATTLEBOROUGH
PLYMOUTH
WAREHAM

List of Towns in Minimum Uniform
Snow Load Zones Zone 2

Abington
Acushnet
Amesbury
Andover
Arlington
Attleboro

Bedford
Belmont
Berkley
Beverly
Billerica
Boston
Boxford
Braintree
Bridgewater
Brockton
Brookline
Burlington

Cambridge
Carlisle
Carver
Chemlsford
Chelsea
Cohasset

Danvers
Dartmouth
Dighton
Dracut
Duxbury

E. Bridgewater
Easton
Essex
Everett

Fairhaven
Fall River

Freetown

Georgetown
Gloucester
Groveland

Halifax
Hamilton
Hanover
Hanson
Haverhill
Hingham
Holbrook
Hull

Ipswich

Kingston

Lakeville

Lawrence
Lexington
Lowell
Lynn
Lynnfield

Malden
Manchester
Mansfield
Marblehead
Marion
Marshfield
Mattapoisett
Medford
Melrose
Merrimac
Methuen
Middleborough
Middleton

Milton

Nahant
New Bedford
Newbury
Newburyport
Newton
N. Andover
N. Attleboro
N. Reading
Norton
Norwell

Peabody
Pembroke
Plymouth
Plympton

Quincy

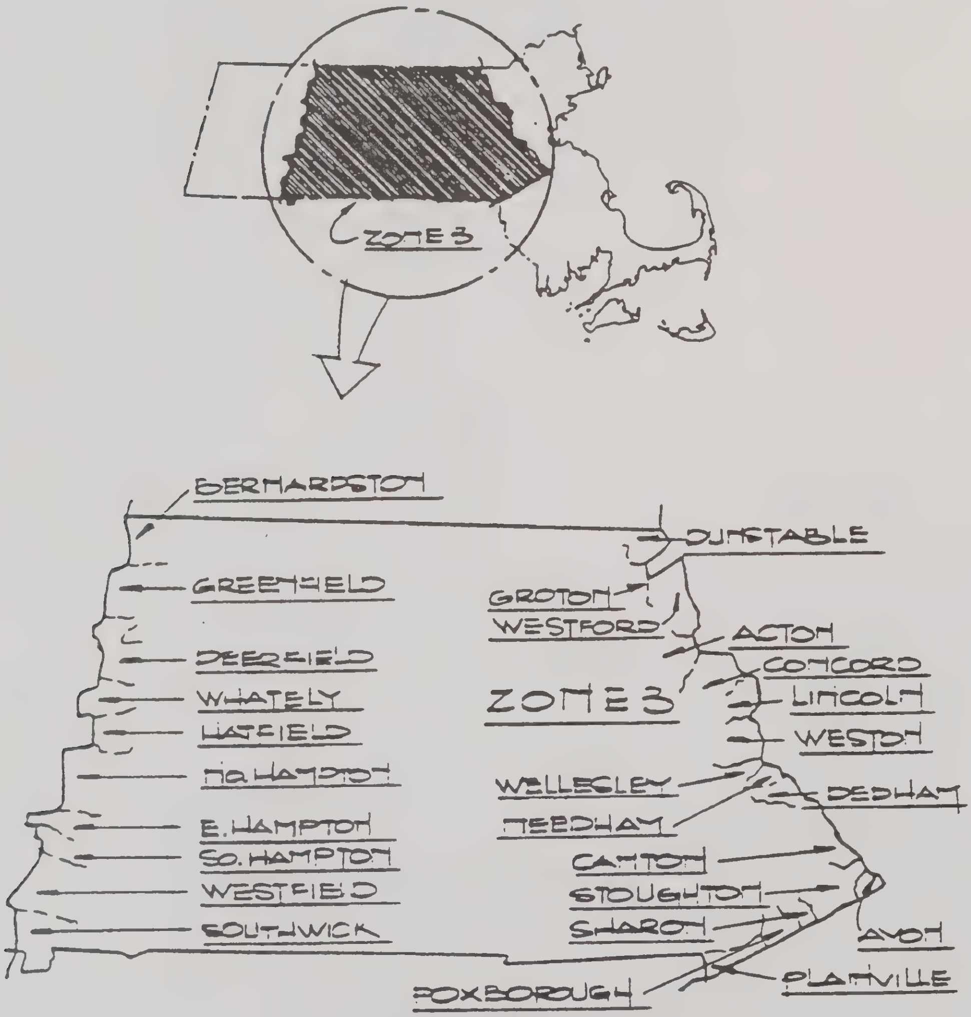
Randolph
Raynham
Reading
Rehoboth
Revere
Rochester
Rockland
Rockport
Rowley

Salem
Salisbury
Saugus
Scituate
Seekonk
Somerset
Somerville
Stoneham
Swampscott
Swansea

Taunton
Tewksbury
Topsfield
Tyngsborough

Wakefield
Waltham
Wareham
Watertown
Wenham
W. Bridgewater
W. Newbury
Westport
Weymouth
Whitman
Wilmington
Winchester
Winthrop
Woburn

Figure 3603.1.5c
MINIMUM UNIFORM SNOW LOAD MAP
ZONE 3


ZONE 3
BERNARDSTON
DUNSTABLE
GREENFIELD
GROTON
WESTFORD
ACTON
DEERFIELD
CONCORD
WHATELY
ZONE 3
LINCOLN
HATFIELD
WESTON
NO. HAMPTON
WELLESLEY
DEDHAM
E. HAMPTON
NEEDHAM
SO. HAMPTON
CANTON
WESTFIELD
STOUGHTON
SOUTHWICK
SHARON
AVON
PLAINVILLE
FOXBOROUGH

List of Towns in Minimum Uniform
Snow Load Zones Zone 3

Acton
Agawam
Amherst
Ashburnham
Ashby
Ashland
Athol
Auburn
Avon
Ayer

Barre
Belchertown
Bellingham
Berlin
Bernardston
Blackstone
Bolton
Boylston
Boxborough
Brimfield
Brookfield

Canton
Charlton
Chicopee
Clinton
Concord

Dedham
Deerfield
Douglas
Dover
Dudley
Dunstable

E. Brookfield
Easthampton
E. Longmeadow
Erving

Fitchburg
Foxborough
Framingham
Franklin

Gardner
Gill
Grafton
Granby
Greenfield
Groton

Hadley
Hampden
Hardwick
Harvard
Hatfield
Holland
Holliston
Holden
Holyoke
Hopedale
Hopkinton
Hubbardston
Hudson

Lancaster
Leicester
Leominster
Leverett
Lincoln
Littleton
Longmeadow
Ludlow
Lunenburg

Marlborough
Maynard
Medfield
Millbury
Millville
Medway
Mendon
Milford
Millis
Monson
Montague

Natick
Needham
New Braintree
New Salem
Norfolk
North Brookfield
Northampton
Northborough
Northbridge
Northfield
Norwood
Oakham
Orange
Oxford

Palmer
Paxton
Pelham
Pepperell
Petersham
Phillipston
Plainville
Princeton

Royalston
Rutland

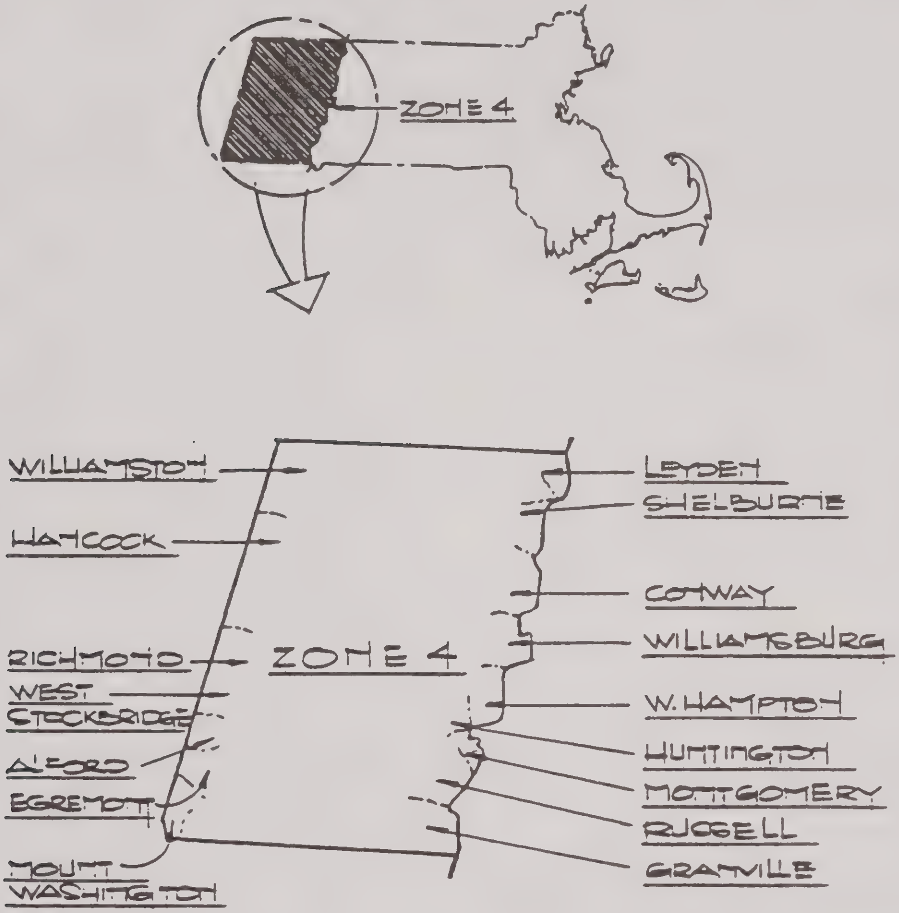
Southbridge
Southwick
Spencer
Springfield
Sterling
Stoughton
Stow
Sturbridge
Sudbury
Sunderland
Suttton
Sharon
Sherborn
Shirley
Shrewsbury
Shutesbury
S. Hadley
Southampton
Southborough

Templeton
Townsend

Upton
Uxbridge

Wales
Walpole
Ware
Warren
Warwick
Wayland
Webster
Wellesley
Wendell
West Boylston
West Brookfield
W. Springfield
Westborough
Westfield
Westford
Westminster
Weston
Westwood
Wilbraham
Winchendon
Whately
Worcester
Wrentham

Figure 3603.1.5d
MINIMUM UNIFORM SNOW LOAD MAP
ZONE 4


ZONE 4
WILLIAMSTON
HANCOCK
RICHMOND
WEST STOCKBRIDGE
ALFORD
EGREMONT
MOUNT WASHINGTON
ZONE 4
LEYDEN
SHELBURNE
CONWAY
WILLIAMSBURG
W. HAMPTON
HUNTINGTON
MONTGOMERY
RUSSELL
GRANVILLE

List of Towns in Minimum Uniform
Snow Load Zones Zone 4

Adams
Alford
Ashfield

Becket
Blandford
Buckland

Charlemont
Cheshire
Chester
Chesterfield
Clarksburg

Colrain
Conway
Cummington

Dalton

Egremont

Florida

Goshen
Granville
Great Barrington

Hancock
Hawley
Heath
Hinsdale
Huntington

Lanesborough
Lee
Lenox
Leyden

Middlefield
Monroe

Monterey
Montgomery
Mount Washington

New Ashford
New Marlborough

North Adams

Otis

Peru
Pittsfield

Plainfield

Richmond
Rowe
Russell

Sandisfield
Savoy
Sheffield
Shelbourne
Stockbridge

Tolland
Tyringham

Washington
W. Stockbridge
Westhampton
Williamsburgh
Williamstown
Windsor
Worthington

Table 3603.1.6
ALLOWABLE LIVE LOAD DEFLECTION OF STRUCTURAL MEMBERS

STRUCTURAL MEMBER	ALLOWABLE DEFLECTION
Rafters having slopes greater than 3 in 12 -no finished ceiling attached to rafters	L/180
Interior walls and partitions	H/180
Floors and veneer plastered ceilings	L/360
Gypsum panel ceilings and all other structural members	L/240

Notes:
L = Span length; H = Span height

780 CMR 3603.2
CONSTRUCTION IN AREAS SUBJECT TO FLOODING

3603.2.1 Flood Resistant Construction: Construction in areas designated as subject to flooding on the community Flood Insurance Rate Map (FIRM) shall be designed and constructed in accordance with the applicable provisions of 780 CMR 3107.

780 CMR 3603.3 FIRERESISTANCE RATING OF EXTERIOR WALLS

3603.3.1 Exterior walls: Exterior walls located less than three feet (0.914m) from property lines shall have a minimum of one-hour fire-resistive rating. The fire-resistive rating of exterior walls located less than three feet (0.914 m) from a property line shall be rated for exposure from both sides. Projections beyond the exterior wall shall not extend more than 12 inches (0.305 m) into areas where openings are prohibited.

3603.3.2 Openings: Openings shall not be permitted in exterior walls of dwellings located less than three feet (914 mm) from the property line. This distance shall be measured perpendicular to the vertical plane of the wall.

780 CMR 3603.4 DWELLING UNIT SEPARATION

3603.4.1 Two-family dwellings: Dwelling units in two-family dwellings shall be separated by wall and/ or floor-ceiling assemblies of not less than one-hour fire-resistive rating when tested in accordance with ASTM E 119, as listed in ***Appendix A***. Fire-resistive-rated floor-ceiling and wall assemblies shall extend to, and be tight against, the exterior wall and wall assemblies shall extend to the underside of the roof sheathing.

3603.4.2 Supporting construction: When floor assemblies are required to be fire-resistive rated by 780 CMR 3603.4.1, the supporting construction of such assemblies shall have an equal or greater fire-resistive rating.

3603.4.3 Sound transmission: Wall and floor-ceiling assemblies separating dwelling units shall provide airborne sound insulation for walls and both airborne and impact sound insulation for floor-ceiling assemblies.

3603.4.3.1 Airborne noise: Airborne sound insulation for wall and floor-ceiling assemblies shall meet a Sound Transmission Class (STC) of 45 when tested in accordance with ASTM E 90.

3603.4.3.2 Penetrations: Penetrations or openings in the assembly for pipes, ventilation or exhaust ducts shall be sealed, lined, insulated or otherwise treated to maintain the required ratings.

3603.4.3.3 Structural-borne noise: Impact sound insulation for floor-ceiling assemblies shall meet an Impact Insulation Class (IIC) of 45 when tested in accordance with ASTM E 492. Floor covering may be included in the assembly to obtain the required rating.

780 CMR 3603.5 GARAGE SEPARATION

3603.5.1 Opening protection: Openings from a private garage directly into a room used for sleeping purposes shall not be permitted. Other openings between the garage and dwelling shall be equipped with either solid wood doors not less than 1¾ inch (45 mm) in thickness or 20-minute fire-rated doors. Self closing devices and fire resistive rated door frames are not required. All door openings between the garage and the dwelling shall be provided with a raised sill with a minimum height of four inches.

3603.5.2 Fire Separation: The garage shall be separated from the residence and its attic area by means of minimum ⅝ inch (16 mm) type X gypsum board applied to the garage side. Wherever the attic area is continuous between the garage and the dwelling a firestop of ⅝ inch (16 mm) type X gypsum board with a minimum of one coat compound and tape shall be used to form a barrier to separate the garage and dwelling.

3603.5.3 Floor surface: Garage and carport floor surfaces shall be constructed of concrete or other approved noncombustible material. Slab on grade construction shall be in accordance with the provisions of 780 CMR 3605.5. The minimum floor thickness shall be 3½ inches. The area of floor used for parking of automobiles or other vehicles shall be sloped to facilitate drainage toward the main vehicle entry/exit doorway.

780 CMR 3603.6 LIGHT, VENTILATION AND HEATING

3603.6.1 Light required: Every room or space intended for human occupancy shall be provided with natural or artificial light.

Exception 1: Every bathroom and toilet room shall, as a minimum, be provided with artificial light.

Exception 2: All interior and exterior stairways shall be provided with artificial light providing direct or indirect illumination and capable of illuminating the entire length of the stairway and associated landings. The control for activation of the required interior stairway lighting shall be installed in accordance with the requirements of 527 CMR 12.00, the Massachusetts State Electrical Code, as listed in *Appendix A*. The illumination of exterior stairs shall be controlled from inside the dwelling

3603.6.2 Ventilation required: Every room or space intended for human occupancy shall be provided with natural or mechanical ventilation.

Exception: Every bathroom and toilet room shall be equipped with a mechanical exhaust fan and associated ductwork with the fan exhausting, as a minimum, at 50 cfm if operated intermittently or 20 cfm if continuously operated. Such bathroom exhaust shall vent directly to the outside and no exhaust vent termination to attics or other interior portions of the building are allowed.

3603.6.3 Heating required: One and two family dwellings shall be designed with heating systems complying with the requirements of 780 CMR 3603.21.

3603.6.4 Natural light

3603.6.4.1 General: Should natural lighting be chosen as a lighting option, in the application of the provisions of 780 CMR 3603.0 for habitable and occupiable rooms, unless otherwise specifically required by the provisions of 780 CMR 4 for special occupancies, the requirements of 780 CMR 3603.6.4.2 through 780 CMR 3603.6.4.6 shall apply.

3603.6.4.2 Minimum glazing area: Every room or space intended for human occupancy shall have an exterior glazing area of not less than 8% of the floor area. ½ of the required area of glazing shall be openable. Glazed openings shall be located such that they open directly onto a street or public alley, or a yard or court, or other open space located on the same lot as the building. Glazed openings are permitted to face into a roofed porch where the porch abuts a street, yard or court, or other open area and the longer side of the porch is at least 65% open and unobstructed and the ceiling height of the porch is not less than seven feet (2134 mm).

Exceptions:

1. Glazed areas need not be openable where the opening is not required by 780 CMR 3603.10.4 and an approved mechanical ventilation system is provided which is capable of producing 0.35 air change per hour in the room or a whole-house mechanical ventilation system is installed capable of supplying outdoor ventilation air of 15 cubic feet per minute (cfm) (7.08 L/s) per occupant computed on the basis of two occupants for the first bedroom and one occupant for each additional bedroom.
2. The glazed areas may be omitted in rooms where the opening is not required by 780 CMR 3603.10.4 and an approved mechanical ventilation system is provided capable of producing 0.35 air change per hour in the room or a whole-house mechanical ventilation system is installed capable of supplying outdoor ventilation air of 15 cfm (7.08 L/s) per occupant computed on the basis of two occupants for the first bedroom and one occupant for each additional bedroom, and artificial light is provided capable of producing an average illumination of six foot-candles (6.46 Ix) over the area of the room at a height of 30 inches (762 mm) above the floor level.

3603.6.4.3 Adjoining spaces: Where natural light for rooms or spaces without exterior glazing areas is provided through an adjoining room, the unobstructed opening to the adjoining room shall be at least 8% of the floor area of the interior room or space, but not less than 25 square feet (2.33 m^2). The exterior glazing area shall be based on the total floor area being served.

3603.6.4.4 Stairways: See 780 CMR 3603.6.1, Exception 2

3603.6.4.5 Hallways: Natural light shall be capable of penetrating the full length of the hallway.

3603.6.4.6 Bathrooms and toilet rooms: See 780 CMR 3603.6.1, Exception 1.

3603.6.5 Artificial light

3603.6.5.1 General: Artificial light shall be capable of providing the minimum illumination considered safe for the specific space application (an average illumination of six foot candles over the area of a room at a height of 30 inches above the floor is typically considered acceptable except for bathrooms and toilet rooms where three foot-candles, so measured is typically considered acceptable).

3603.6.6 Natural ventilation

3603.6.6.1 General: Natural ventilation of an occupied space shall be provided by means of windows, doors, louvers or other natural openings to the outdoor air.

3603.6.6.2 Ventilation area required: The minimum openable area to the outdoors shall be 4% of the floor area being ventilated.

3603.6.6.2.1 Adjoining spaces: Where rooms and spaces without openings to the outdoors are ventilated through an adjoining room, the unobstructed opening to the adjoining room shall be at least 8% of the floor area of the interior room or space, but not less than 25 square feet (2.33 m^2). The ventilation openings to the outdoors shall be based on the total floor area being ventilated.

3603.6.6.2.2 Bathrooms and toilet rooms: See 780 CMR 3603.6.2, Exception.

3603.6.6.2.3 Openings below grade: Openings below grade shall be acceptable for natural ventilation provided that the outside horizontal clear space measured perpendicular to the opening is 1½ times the depth below the average adjoining grade.

3603.6.6.3 Openings onto yards, courts or open areas: Natural ventilation shall be provided by openings onto yards, courts or other open space on the same lot.

3603.6.7 Mechanical ventilation

3603.6.7.1 General: Mechanical ventilation shall conform to the requirements of 780 CMR 36 and otherwise to the requirements of the BOCA National Mechanical Code listed in ***Appendix A***.

3603.6.8 Ventilation of special spaces

3603.6.8.1 Roof spaces: Enclosed attics and enclosed rafter spaces formed where ceilings are applied directly to the underside of roof rafters, shall have cross ventilation for each separate space by ventilation openings that are protected against the entrance of rain and snow. The openings shall be covered with corrosion-resistant mesh not less than ¼ inch (6 mm) nor more than ½ inch (13 mm) in any direction, or other approved screening which allows for ventilation.

3603.6.8.1.1 Ventilating area: The minimum required net free ventilating area for such roof spaces shall be $^1/_{150}$ of the area of the space ventilated, except that the minimum required area shall be reduced to $^1/_{300}$, provided that: a vapor retarder having a permeance not exceeding one perm is installed on the warm side of the ceiling; or at least 50% and not more than 80%, of the required ventilating area is provided by ventilators located in the upper portion of the space to be ventilated at least three feet (914 mm) above eave or cornice vents, with the balance of the required ventilation provided by eave or cornice vents.

3603.6.8.2 Basements, cellars and crawl spaces: All basements, cellars which are not used as *habitable, occupiable* space, and crawl spaces, shall be ventilated by openings in exterior foundation walls, by openable windows or by approved mechanical means. Openings or openable windows shall be located as near as practical to provide cross ventilation. The openings shall be covered with corrosion resistant mesh not less than ¼ inch (6 mm) nor more than ½ inch (13 mm) in any direction, or other approved screening which allows for ventilation except than when openable windows are used for basement or cellar ventilation, standard window screens may be used as the corrosion resistant mesh.

Note: Crawl spaces shall not be used as an underfloor plenem.

Exception:

1. Basements or cellars used as *habitable, occupiable space* (Typically basements and cellars are not classified as habitable, occupiable space - see Definitions, 780 CMR 2 and 1202) shall satisfy the ventilation requirements of 780 CMR 3603.6.6 or 780 CMR 3603.6.7, as applicable.
2. All basements and cellars containing solid fuel fired or fossil fired appliances shall additionally satisfy combustion air requirements of 780 CMR 3611.1

3603.6.8.2.1 Opening size: Openings or openable windows shall have a net area of not less than one square foot (0.093 m^2) for each 150 square feet (13.95 m^2) of foundation floor area. Where an approved vapor retarder is installed over the ground surface, the required net area of openings shall be reduced to 0.1 square foot (0.093 m^2) for each 150 square feet (13.95 m^2) and where vents are provided, they shall have manually operable louvers.

Exception: Basements and cellars not used as habitable, occupiable space shall be provided with a minimum of four sliding type, or awning type basement windows for every 1500 square feet of floor area, or multiples thereof, and shall be located, as near as practical, to provide cross ventilation.

3603.6.8.3 Alternative mechanical ventilation: Enclosed attics, rafter, basement, cellar and crawl spaces which are not ventilated as herein required shall be equipped with a mechanical ventilation system conforming to the requirements of the BOCA National Mechanical Code listed in ***Appendix A***.

780 CMR 3603.7 ROOM DIMENSIONS

3603.7.1 Floor area: Habitable rooms, except kitchens, shall have an area of not less than 70 square feet (6.51 m^2). Every kitchen shall have not less than 50 square feet (4.64 m^2) Habitable rooms, except kitchens shall not be less than seven feet (2134 mm) in any horizontal direction.

780 CMR 3603.8 CEILING HEIGHT REQUIREMENTS

3603.8.1 Minimum ceiling height: *Habitable rooms*, except kitchens, shall have a ceiling height of not less than seven feet three inches (2210 mm) for at least 50% of their required areas. Not more than 50% of the required area may have a sloped ceiling less than seven feet three inches (2210 mm) in height with no portion of the required areas less than five feet (1524 mm) in height. If any room has a *furred ceiling*, the prescribed ceiling height is required for at least 50% of the area thereof, but in no case shall the height of the *furred ceiling* be less than seven feet (2134 mm).

Exceptions:

1. Beams and girders spaced not less than four feet (1219 mm) on center may project not more than six inches (153 mm) below the required ceiling height.
2. All other rooms including kitchens, bathrooms and hallways shall have a minimum ceiling height of seven feet (2134 mm) measured to the lowest projection from the ceiling.
3. Habitable basements shall have a minimum clear ceiling height of seven feet zero inches, except that beams, girders and other obstructions spaced not less than four feet on center may project not more than six inches below the required ceiling height.
4. Basements not used for *habitable* spaces shall have a minimum clear ceiling height of six feet eight inches (2032 mm) except for under beams, girders, ducts or other obstructions where the clear height shall be a minimum of six feet four inches (1931 mm).

3603.8.2 Height effect on room area: Portions of a room with a sloping ceiling measuring less than five feet zero inches (1524 mm) or a *furred ceiling* measuring less than seven feet zero inches (2134 mm) from the finished floor to the finished ceiling shall not be considered as contributing to the minimum required habitable area for that room.

3603.8.3 Stairway ceiling height: Stairway headroom clearances shall be in accordance with the provisions of 780 CMR 3603.13.3.

780 CMR 3603.9 ACCESS TO CRAWL SPACES AND ATTICS

3603.9.1 Access to crawl spaces: Access shall be provided to crawl spaces by an opening not less than 18 inches (457 mm) by 24 inches (610 mm).

3603.9.2 Access to attics: An opening not less than 22 inches by 30 inches (559 mm by 762 mm) with ready access thereto shall be provided to any attic area having a clear height of over 36 inches (914 mm). Where doors or other openings are installed in the draftstopping, such doors shall be self-closing and be of approved materials as specified in this section, and the construction shall be tightly fitted around all pipes, ducts or other assemblies piercing the draftstopping.

780 CMR 3603.10 MEANS OF EGRESS

3603.10.1 Means of egress: Egress from all dwelling units shall be by means of two exit doors, remote as possible from each other and leading directly to grade. Such doors shall be provided at the normal level of entry/exit. In addition, all other floors within a dwelling unit shall have at least one means by which a continuous and unobstructed path to the exit doors, by means of stairways, corridors, hallways or combinations thereof, is provided.

Exception: In split level and raised ranch style layouts, the two separate exit doors required by 780 CMR 3603.10.1 are permitted to be located on different levels.

3603.10.2 Exit doors: One of the required exit doors required by 780 CMR 3603.10.1 shall be a side-hinged swinging door. The second exit door may be provided by a side-hinged swinging door or sliding type doors. Side hinged swinging doors provided to meet this requirement may swing inward.

3603.10.3 Door hardware: Double cylinder dead bolts requiring a key operation on both sides are prohibited on required means of egress doors serving more than one dwelling unit.

3603.10.4 Emergency egress from sleeping rooms: Sleeping rooms shall have at least one openable window or exterior door approved for emergency egress or rescue in each such room. The units shall be operable from the inside to a full clear opening without the use of a key or tool. Emergency escape windows, under 780 CMR 3603.10.4, shall have a sill height of not more than 44 inches (1118 mm) above the floor.

3603.10.4.1 Minimum size. All emergency escape windows from sleeping rooms shall have a net clear opening of 3.3 square feet (0.307 m^2). The minimum net clear opening shall be 20 inches by 24 inches in either direction.

Exception: Windows in sleeping rooms of existing dwellings which do not conform to the requirements of 780 CMR 3603.10.4.1 may be replaced without conforming to 780 CMR 3603.10.4.1, provided that the replacement windows do not significantly reduce the existing opening size.

3603.10.4.2 Bars, grills and screens: Bars, grills, screens or other obstructions placed over emergency escape windows shall be releasable or removable from the inside without the use of a key or tool.

3603.10.5 Exitway under stair protection: Enclosed accessible space under stairs shall have walls and soffits protected on the enclosed side with ½-inch (12.7 mm) gypsum board.

780 CMR 3603.11 DOORS AND HALLWAYS

3603.11.1 Exit doors: The minimum nominal width of at least one of the exit doors required by 780 CMR 3603.10.1 shall be 36 inches and the minimum nominal height shall be six feet eight inches. All other exit doors and doors leading to or from enclosed stairways, shall not be less than 32 inches in nominal width nor six feet eight inches in nominal height.

Exceptions:

1. Existing Buildings: New and replacement doors are permitted to be six feet six inches in nominal height.
2. Sliding type doors utilized as a second means of egress shall not be less than six feet six inches in nominal height.

3603.11.2 Interior Doors: All doors providing access to habitable rooms shall have a minimum nominal width of 30 inches and a minimum nominal height of six feet six inches.

Exception:

1. Doors providing access to bathrooms are permitted to be 28 inches in nominal width.
2. Existing Buildings: Doors providing access to bathrooms are permitted to be 24 inches in nominal width.

780 CMR 3603.12 LANDINGS

3603.12.1 General: A minimum of three foot by three foot (914 mm by 914 mm) landing or open floor area shall be provided at the interior side of all exit doors. A minimum 48 inches wide by 42 inches deep landing shall be provided on the exterior side of all exit doors. The floor area or landing shall not be more than 1½ inches (38 mm) lower than the top of the threshold on the interior side, nor more than 8¼ inches lower than the threshold on the exterior side.

Exceptions:

1. At the top of a flight of interior stairs, on the stairway side, provided the door does not swing over the stairs.
2. For sliding type doors, or other doors where the threshold is located eight inches or less above the adjacent exterior finished grade.

780 CMR 3603.13 STAIRWAYS

3603.13.1 Width: Stairways shall not be less than 36 inches (914 mm) in clear width at all points above the permitted handrail height and below the required headroom height. The minimum width at and below the handrail height shall not be less than 32 inches (813 mm) where a handrail is installed on one side and 28 inches (711 mm) where handrails are provided on both sides.

3603.13.2 Treads and risers: The maximum riser height shall be 8¼ inches (210 mm) and the minimum tread depth shall be nine inches (229 mm). The riser height shall be measured vertically between leading edges of the adjacent treads. The tread depth shall be measured horizontally between the vertical planes of the foremost projection of adjacent treads and at a right angle to the tread's leading edge. The walking surface of treads and landings of a stairway shall be sloped no steeper than one unit vertical in 48 units horizontal (2% slope). The greatest riser height within any flight of stairs shall not exceed the smallest by more than ⅜ inch (9.5 mm) and any two successive risers shall not deviate by more than $^{3}/_{16}$-inch in height. The greatest tread depth within any flight of stairs shall not exceed the smallest by more than ⅜ inch (9.5 mm) and any two successive treads shall not deviate in depth by more than $^{3}/_{16}$-inch.

3603.13.2.1 Nosings: Nosings shall not project more than 1½ inches beyond the face of the riser below.

3603.13.3 Headroom: The minimum headroom in all parts of the stairway shall not be less than six feet six inches (1981 mm) measured vertically from the sloped plane adjoining the tread nosing or from the floor surface of the landing or platform.

3603.13.4 Winders: Winders are permitted, provided that the width of the tread at a point not more than 12 inches (305 mm) from the side where the treads are narrower is equal to the tread depth of the straight run portion of the stairs and the minimum width of any tread is not less than six inches (153 mm). The continuous handrail required by 780 CMR 3603.14.1 shall be located on the side where the tread is narrower.

3603.13.5 Spiral stairs: Spiral stairways are permitted, provided the minimum width shall be 26 inches (660 mm) with each tread having a 7½-inch

(190 mm) minimum tread width at 12 inches (305 mm) from the narrow edge. All treads shall be identical, and the rise shall be no more than 9½ inches (241 mm). A minimum headroom of six feet six inches (1982 mm) shall be provided.

3603.13.6 Circular stairways: Circular stairways shall have a minimum tread depth and a maximum riser height in accordance with 780 CMR 3603.13.2 and the smaller radius shall not be less than twice the width of the stairway. The minimum tread depth of ten inches (254 mm) shall be measured from the narrower end.

3603.13.7 Illumination: All stairways shall be provided with artificial illumination in accordance with 780 CMR 3603.6.1 (exception 2).

780 CMR 3603.14 HANDRAILS AND GUARDRAILS

3603.14.1 Handrails:

3603.14.1.1 Handrails: Handrails having minimum and maximum heights of 30 inches and 38 inches (762 mm and 965 mm), respectively, measured vertically from the nosing of the treads, shall be provided on at least one side of stairways of three or more risers. Spiral stairways shall have the required handrail located on the outside radius. All required handrails shall be continuous the full length of the stairs. Ends shall be returned or shall terminate in newel posts or safety terminals. Handrails adjacent to a wall shall have a space of not less than 1½ inches (38 mm) between the wall and the handrail.

Exceptions:

1. Handrails shall be permitted to be interrupted by a newel post at a turn.
2. The use of a volute, turnout or starting easing shall be allowed over the lowest tread.

3603.14.1.2 Handrail grip size: Stairway handrails shall have a circular cross section with an outside diameter of at least 1¼ inches and not greater than two inches.

Exceptions:

1. Any other shape with a perimeter dimension of at least four inches but not greater than 6¼ inches (159 mm) with the largest cross-sectional dimension not exceeding 2⅝ inches.
2. Approved handrails of equivalent graspability.

3603.14.2 Guardrails:

3603.14.2.1 Guardrail details: Porches, balconies, decks or raised floor surfaces located more than 30 inches (762 mm) above the floor or grade below shall have guardrails not less than 36 inches (914 mm) in height. Open sides of stairs with a total rise of more than 30 inches (762 mm) above the floor or grade below shall have guardrails, which may also serve as handrails, not less than 34 inches (864 mm) in height measured vertically from the nosing of the treads.

3603.14.2.2 Guardrail opening limitations: Required guardrails on open sides of stairways, balconies, porches, decks and raised floor areas, shall have intermediate rails, balusters or ornamental closures which prevent the passage of an object five inches (127 mm) or more in diameter.

Exception: Triangular spaces formed by the riser, tread and bottom rail of a guard at the open side of a stairway may be of sized to prevent the passage of a sphere six inches (153 mm)in diameter.

780 CMR 3603.15 RAMPS

3603.15.1 Maximum slope: All egress ramps shall have a maximum slope of one unit vertical in eight units horizontal (12.5% slope).

Exception 1: The maximum slope of ramps for persons with disabilities shall be one unit vertical in 12 units horizontal.

Exception 2: Where access for persons with disabilities is legally mandated, ramps shall be constructed in accordance with the requirements of 521 CMR as listed in ***Appendix A***.

3603.15.2 Guardrails and handrails: Guardrails shall be provided on both sides of all ramps and shall be constructed in accordance with 780 CMR 3603.14.2. Handrails conforming to 780 CMR 3603.14.1 shall be provided on at least one side of all ramps exceeding a slope of one unit vertical in 12 units horizontal (8% slope).

Exception 1: For persons with disabilities, handrails shall be provided on both sides of the ramp when the vertical rise between landings exceeds six inches.

Exception 2: Where access for persons with disabilities is required by statute, ordinance or bylaw, guardrails and handrails shall be provided in accordance with the requirements of 521 CMR as listed in *Appendix A*.

3603.15.3 Landing required: A minimum three-foot-by-three-foot (914 mm by 914 mm) level landing shall be provided at the top and bottom of ramps where doors open onto the ramp and where the ramp changes direction.

Exception 1: Ramps required for persons with disabilities shall not have a vertical rise greater than 30 inches between landings.

Exception 2: Where access for persons with disabilities is legally mandated, landing requirements shall conform to the requirements of 521 CMR as listed in ***Appendix A***.

780 CMR 3603.16 FIRE PROTECTION SYSTEMS

3603.16.1 General: All one and two family dwellings hereafter constructed shall be equipped with a *household fire warning system*, in accordance with the provisions of 780 CMR 3603.16. All devices shall be installed and maintained in accordance with the requirements of 780 CMR 3603.16, manufacturers instructions and listing criteria and otherwise shall be installed and maintained in accordance with Chapter 2 of NFPA 72 and 527 CMR 12.00 as listed in ***Appendix A***.

> **Exception**: In addition to the requirements of 780 CMR 3603.16.1, two family dwellings that contain common areas such as basements, hallways and/or interior stairways that serve both dwelling units, but are not within the dwelling units shall be provided with multiple station smoke detectors or a listed control unit with automatic smoke detectors and occupant notification appliances in the following locations.
>
> 1. In all common basements.
> 2. In all common hallways.
> 3. In all common stairways on each level outside the dwelling unit doorways.
>
> Each detection device shall cause the operation of an alarm that is clearly audible in all bedrooms over background noise levels with all intervening doors closed. Such devices shall be installed in accordance with NFPA 72 and 527 CMR 12.00 as listed in ***Appendix A***.

3603.16.2 Compatibility: All devices and/or combination of devices and equipment shall be approved and listed for the purposes for which such devices are to be utilized.

3603.16.3 Smoke detectors: All detached one- and two family buildings, including *manufactured homes* in accordance with 780 CMR 35, shall contain listed single and multiple station smoke detectors or other *household fire warning systems* in compliance with ANSI/UL 217 and/or ANSI/UL 268 (listed in Appendix A) and conforming to 780 CMR 3603.16; *such household fire warning systems* shall be installed and maintained in accordance with the requirements of 780 CMR 3603.16, manufacturers instructions and listing criteria and otherwise shall be installed and maintained in accordance with Chapter 2 of NFPA 72 and 527 CMR 12.00 as listed in ***Appendix A***.

3603.16.4 Heat detectors: (Reserved).

3603.16.5 Primary electrical power for single station and multiple station smoke detectors: Power for single and multiple station smoke detectors shall be supplied from a permanently wired connection directly to an AC primary source of power. All power for AC powered smoke detectors shall be taken from a single branch circuit which also provides other electrical service to *habitable, occupiable spaces*. The power source shall be on the supply side, ahead of any switches.

3603.16.6 Primary electrical power for other *household fire warning systems*: Low voltage *household fire warning systems* that include a listed control unit with automatic detectors and occupant notification appliances shall be powered from a permanently wired AC primary power source. Such AC primary power shall be supplied either from a dedicated branch circuit or the unswitched portion of a branch circuit also used for power and lighting of *habitable, occupiable spaces*, in accordance with the requirements of NFPA 72 and 527 CMR 12.00 as listed in ***Appendix A***.

3603.16.7 Secondary electrical power: In addition to required primary power as discussed in 780 CMR 3603.16.5 and 780 CMR 3603.16.6, all household fire warning systems shall have secondary (standby) power supplied from monitored batteries in accordance with the household fire warning equipment requirements of NFPA-72 as listed in ***Appendix A***.

3603.16.8 Required alarm notification appliances: Where more than one smoke or heat detector is required by 780 CMR 3603.16.10, all required detectors shall be installed so that the activation of any detector shall cause the alarm in all required smoke detectors in the dwelling unit to sound.

Detector activation in a dwelling unit shall not activate signals in any other dwelling unit or common areas.

3603.16.9 Alarm signaling intensity: All required alarm-sounding appliances shall have a minimum rating of 85 dBA at ten feet in accordance with the requirements of NFPA 72.

> **Exception**: Sounding appliances directly located in bedrooms shall have a sound pressure level as low as 75 dBA at ten feet in accordance with the requirements of NFPA 72.

3603.16.10 Required smoke detector/heat detector locations: Smoke detectors shall be installed in the following locations:

1. In the immediate vicinity of bedrooms;
2. In all bedrooms;

3. In each story of a dwelling unit, including basements and cellars, but not including crawl spaces and uninhabitable attics;
4. In residential units of 1200 square feet or more, automatic fire detectors, in the form of smoke detectors shall be provided for each 1200 square feet of area or part thereof;
5. Fixed temperature heat detectors shall be installed in accordance with the requirements of 780 CMR 3603.16.4.

Exceptions:
1. In dwelling units with one or more split levels, (i.e., adjacent levels with less than one full story separation between levels) a smoke detector installed on the upper level shall suffice for the adjacent lower level unless there is an intervening door between one level and the adjacent lower level in which case smoke detectors shall be installed on both levels.
2. In buildings equipped throughout with an automatic sprinkler system, smoke detectors are not required in bedrooms.

3603.16.11 Photo electric smoke detector requirements: Any smoke detector located within 20 feet of a kitchen or within 20 feet of a bathroom containing a tub or shower shall be a photo electric type smoke detector but shall satisfy the compatibility requirements of 780 CMR 3603.16.2.

3603.16.12 Maintenance and testing: It shall be the responsibility of the *owner* to properly maintain the household fire warning system in accordance with the requirements of NFPA 72 as listed in ***Appendix A***.

3603.16.13 Additions, alterations and repairs: When one or more sleeping rooms are added or created in existing dwellings, the entire building shall be provided with smoke detectors designed and located as required for new dwellings.

For other alterations or repairs that would require a fire protection system in an existing building be upgraded, refer to 780 CMR 3404 and/or 780 CMR 3405, as applicable.

780 CMR 3603.17 FOAM PLASTIC

3603.17.1 General: The provisions of this section shall govern the requirements and uses of foam plastic insulation.

3603.17.1.1 Surface burning characteristics: Except where otherwise noted in 780 CMR 3603.17.2, all foam plastic or foam plastic cores in manufactured assemblies used in building construction shall have a flame-spread rating of not more than 75 and shall have a smoke-developed rating of not more than 450 when tested in the maximum thickness intended for use in accordance with ASTM E 84.

3603.17.1.2 Thermal barrier: Foam plastic, except where otherwise noted, shall be separated from the interior of a building by minimum ½-inch (12.7 mm) gypsum wallboard. The gypsum board shall be installed using a mechanical fastening system in accordance with 780 CMR 3607.2.3.5. Reliance on adhesives to ensure the gypsum wallboard will remain in place when exposed to fire shall be prohibited.

3603.17.2 Specific requirements: The following requirements shall apply to all uses of foam plastic unless specifically approved in accordance with 780 CMR 3603.17.3 or by other sections of 780 CMR.

3603.17.2.1 Masonry or concrete construction: Foam plastics may be used without the thermal barrier described in 780 CMR 3603.17.1.2 when the foam plastic is protected by a minimum one-inch (25 mm) thickness of masonry or concrete.

3603.17.2.2 Roofing: Foam plastic may be used in a roof-covering assembly without the thermal barrier when the foam is separated from the interior of the building by plywood or wood structural panel sheathing in accordance with 780 CMR 3608.3, not less than $^{15}/_{32}$ inch (12 mm) in thickness bonded with exterior glue and identified as Exposure 1, with edge supported by blocking or tongue-and-groove joints. The smoke-developed rating shall not be limited.

3603.17.2.3 Attics: Within an attic accessible by means of a fixed stairway, foam plastics shall be protected against ignition by 1½-inch-thick (38 mm) mineral fiber insulation, ¼-inch-thick (6.4 mm) wood structural panels, ⅜-inch (9.5 mm) particleboard, ¼-inch (6.4 mm) hardboard, or ⅜-inch (9.5 mm) gypsum wallboard, corrosion-resistant steel having a base metal thickness of 0.016 inch (0.406 mm).

3603.17.2.4 Foam-filled doors: Foam-filled doors are exempt from the requirements of 780 CMR 3603.17.

3603.17.2.5 Siding backer board: Foam plastic board of not more than ½-inch (12.7 mm) thickness may be used as siding backer board when separated from interior spaces by not less than two inches (51 mm) of mineral fiber insulation or ½-inch (12.7 mm) gypsum wallboard or installed over existing exterior wall finish in conjunction with re-siding, providing the plastic board does not have a potential heat of more than 2,000 Btu per square foot (22 720 kJ/m^2) when tested in accordance with NFiPA 259.

3603.17.2.6 Interior trim: Foam plastic trim defined as picture molds, chair rails, baseboards, handrails, ceiling beams, door trim and window trim may be installed, provided:

1. The minimum density is 20 pounds per cubic foot (3.14 kN/m^3);
2. The maximum thickness of the trim is ½ inch (12.7 mm) and the maximum width is four inches (102 mm);
3. The trim constitutes no more than 10% of the area of any wall or ceiling, and
4. The flame-spread rating does not exceed 75 when tested per ASTM E 84. The smoke-developed rating is not limited.

3603.17.3 Specific approval: Plastic foam not meeting the requirements of 780 CMR 3603.17.1 and 3603.17.2 may be specifically approved on the basis of approved tests such as, but not limited to, a tunnel test in accordance with ASTM E 84, FM 4880, UL 1040, ASTM E 152, or UL 1715, or fire tests related to actual end-use configurations. The specific approval may be based on the end use, quantity, location and similar considerations where such tests would not be applicable or practical.

3603.17.4 Interior finish: Foam plastics which are used as interior finish shall also meet the flame-spread requirements for interior finish.

780 CMR 3603.18 INTERIOR FINISH REQUIREMENTS/FLAME SPREAD AND SMOKE DEVELOPED

3603.18.1 Wall and ceiling: Wall and ceiling finishes shall have a flame-spread classification of not greater than 200.

> **Exception**: Flame-spread requirements for finishes shall not apply to trim defined as picture molds, chair rails, baseboards and handrails; to doors and windows or their frames; or to materials which are less than $^1/_{28}$ inch (0.907 mm) in thickness cemented to the surface of walls or ceilings if these materials have a flame-spread characteristic no greater than paper of this thickness cemented to a noncombustible backing.

3603.18.2 Smoke density: The smoke density shall not be greater than 450.

3603.18.3 Testing. Tests shall be made in accordance with ASTM E 84.

780 CMR 3603.19 INSULATION/FLAME SPREAD, SMOKE DEVELOPED/CRITICAL RADIANT FLUX

3603.19.1 Insulation: All exposed insulation materials, including facings, such as vapor barriers or breather papers installed within floor-ceiling assemblies, roof-ceiling assemblies, wall assemblies, crawl spaces and attics shall have a flame-spread rating not to exceed 25 with an accompanying smoke developed factor not to exceed 450 when tested in accordance with ASTM E 84.

> **Exception**: When such materials are installed in concealed spaces, the flame-spread and smoke-development limitations do not apply to the facings, provided that the facing is installed in substantial contact with the unexposed surface of the ceiling, floor or wall finish.

3603.19.2 Loose-fill insulation: Loose-fill insulation-materials which cannot be mounted in the ASTM E 84 apparatus without a screen or artificial supports shall have a flame-spread rating not to exceed 25 with an accompanying smoke-developed factor not to exceed 450 when tested in accordance with CAN4-S102.2-M83.

3603.19.3 Exposed attic insulation: All exposed insulation materials installed on attic floors shall have a critical radiant flux not less than 0.12 watt per square centimeter.

3603.19.4 Testing: Tests for critical radiant flux shall be made in accordance with ASTM E 970.

780 CMR 3603.20 GLAZING

3603.20.1 Scope: The provisions of 780 CMR 3603.20 and 780 CMR 24 shall govern the materials, design, construction and quality of glass and glazing in vertical and sloped applications. For the definition of approved light-transmitting plastic, see 780 CMR 2604.1. ***Safety glazing materials shall conform to the requirements of M.G.L. c. 143, §§ 3T, 3U, and 3V, and CPSC 16 CFR; 1201, as applicable.***

3603.20.2 Marking: Each light shall bear the manufacturer's **mark** designating the type and thickness of glass. Labels may be omitted from other than safety glazing materials unless specifically required by the building official. Safety glazing shall be marked in accordance with 780 CMR 3603.20.1 ***and shall conform to the requirements of M.G.L. c. 143, §§ 3T, 3U, and 3V.*** The mark shall not be omitted from tempered glass. Each unit of tempered glass shall be permanently identified by the manufacturer's mark. The identifying mark shall be etched or ceramic fired on the glass and shall be visible when the unit is glazed.

3603.20.2.1 Identification: To qualify as glass with special performance characteristics, each unit of laminated, heat-strengthened, tempered glass shall be permanently identified by the manufacturer. The identification of tempered glass shall be etched or ceramic fired on the glass and be visible when the unit is glazed. Heat-strengthened and tempered spandrel glasses are exempted from permanent labeling. This type of glass shall be labeled with a removable paper label by the manufacturer.

3603.20.3 Louvered windows or jalousies: Regular, float, wired or patterned glass in jalousies and louvered windows shall be no thinner than nominal 3/16 inch (4.76 mm) and no longer than 48 inches (1219 mm). Exposed glass edges shall be smooth. Wired glass with wire exposed on longitudinal edges shall not be used in jalousies or louvered windows.

3603.20.4 Safety glazing:

3603.20.4.1 Human impact loads: Individual glazed areas, including glass mirrors, in hazardous locations such as those indicated in 780 CMR 2405.2 shall pass the test requirements of CPSC 16 CFR; 1201 ***and shall conform to the requirements of M.G.L. c. 143, §§ 3T, 3U and 3V, as applicable***, listed in ***Appendix A***. The requirements of this section and 780 CMR 2405.2 and 2407.0 shall apply equally to replacement glass and new glass installation. Additional requirements as specified in 780 CMR 2407.2 are to be satisfied for glass used in locations where the hazard is of a continuous nature, such as glass enclosures for sporting activities as identified in 780 CMR.

Exceptions:

1. Polished wired glass used in required fire resistance rated assemblies ***or polished wire glass used in hazardous locations such as those indicated in 780 CMR 3603.20.4.2, items 6,7,8 and 9*** shall comply with ANSI Z97.1, listed in ***Appendix A.***
2. Plastic glazing shall meet the weathering requirements of ANSI Z97.1 listed in *Appendix A*.
3. Glass-block walls shall comply with 780 CMR 2115.0.

3603.20.4.1.1 Identification: Each light of safety glazing material installed in hazardous locations as defined in 780 CMR 3603.20.4.2 shall bear a permanent identifying mark issued by an approved agency which specifies the marking agency, whether manufacturer or installer, and the test standard.

Exceptions:

1. Polished wire glass is exempt from a permanent identifying mark provided that the distributor or the installer provides an affidavit certifying that the polished wire glass complies with ANSI Z97.1 listed in Appendix A.

2. Laminated glass is exempt from a permanent identifying mark provided that the distributor or installer provides an affidavit certifying that the laminated glass complies with CPSC 16 CFR 1201, listed in Appendix A.

3603.20.4.2 Specific hazardous locations: The following shall be considered specific hazardous locations for the purposes of glazing:

1. Glazing in ingress and means of egress doors except jalousies (see 780 CMR 2402.5).
2. Glazing in fixed and sliding panels of sliding (patio) door assemblies and panels in swinging doors.
3. Glazing in storm doors.
4. Glazing in all unframed swinging doors.
5. Glazing in doors and enclosures for hot tubs, whirlpools, saunas, steam rooms, bathtubs and showers. Glazing in any portion of a building wall enclosing these compartments where the bottom exposed edge of the glazing is less than 60 inches (1525 mm) above a standing surface.
6. Glazing in an individual fixed or operable panel adjacent to a door where the nearest exposed edge of the glazing is within a 24-inch (610 mm) arc of either vertical edge of the door in a closed position and where the bottom exposed edge of the glazing is less than 60 inches (1525 mm) above the walking surface.
7. Glazing in an individual fixed or operable panel, other than in those locations described in 780 CMR 3603.20.4.2 items 5. and 6., which meets all of the following conditions:
   a. Exposed area of an individual pane greater than nine square feet (0.84 m^2);
   b. Exposed bottom edge less than 18 inches (460 mm) above the floor:
   c. Exposed top edge greater than 36 inches (915 mm) above the floor; and
   d. One or more walking surface(s) within 36 inches (915 mm) horizontally of the plane of the glazing.
8. All glazing in guards and railings regardless of area or height above a walking surface. Included are structural baluster panels and nonstructural in-fill panels.
9. Glazing in walls and fences enclosing indoor and outdoor swimming pools where the bottom edge of the glazing on the pool side is less than 60 inches (1525 mm) above a walking surface and within 36 inches (914 mm) horizontally of a walking surface. This shall apply to single glazing and all panes in multiple glazing.

Exception: The following products, materials and uses shall not be considered specific hazardous locations:

1. Glazed openings in doors through which a three-inch (76 mm) sphere is unable to pass.
2. Assemblies of leaded glass or faceted glass and items of carved glass used for decorative purposes in locations described in 780 CMR 3603.20.4.2, items 1., 6. or 7.

3. Glazing as described in 780 CMR 3603.20.4.2, item 6., where there is an intervening wall or some other permanent barrier that will prevent a person approaching the door from accidentally striking the glazing.
4. Glazing as described in 780 CMR 3603.20.4.2, item 7., where a protective bar is installed 34 inches to 38 inches (864 mm to 965 mm) above the floor on the side of the glazing having access thereto. The bar shall be capable of withstanding a horizontal load of 50 pounds per linear foot (730 N/m) without contacting the glass and be a minimum of 1½ inches (38 mm) in height. ***The protective bar may be an applied bar or an integral part of the glazed framing dividing an upper lite from a lower lite.***
5. Outboard panes in insulating glass units and other multiple-glazed panels as described in 780 CMR 3603.20.4.2, item 7., where the bottom exposed edge of the glass is 25 feet (7620 mm) or more above any grade, roof, walking surface or other horizontal or sloped (within 45 degrees of horizontal) surface adjacent to the glass exterior.
6. Louvered windows and jalousies complying with the requirements of 780 CMR 3603.20.3.
7. Glazing, including mirrors, mounted or hung on a surface that provides a continuous backing support.

3603.20.5 Sloped glazing and skylights

Note: Also refer to 780 CMR 2404.0 and 2405.0.

3603.20.5.1 Sloped glazing: Any installation of glass or other transparent, translucent or opaque glazing material which is installed at a slope of 15 degrees (0.26 rad) or more from the vertical plane —including skylights, roofs and sloped walls—shall comply with 780 CMR 3603.20.5.

3603.20.5.2 Allowable glazing materials: Sloped glazing shall be any of the following materials, subject to the limitations specified in 780 CMR 3603.20.5.3 and the exceptions specified in 780 CMR 3603.20.5.4:

1. For monolithic glazing systems, the glazing material of the single light or layer shall be laminated glass with a minimum 30-mil (762 μm) polyvinyl butyral interlayer, wired glass, approved plastic materials, heat-strengthened glass or fully tempered glass.
2. For multiple-layer glazing systems, each light or layer shall consist of any of the glazing materials specified in 780 CMR 3603.20.5.2, item 1.

For additional requirements for plastic skylights, see 780 CMR 2608.0.

3603.20.5.3 Limitations: Where used in monolithic glazing systems, heat-strengthened glass and fully tempered glass shall have screens installed below the glazing material, subject to the exceptions in 780 CMR 3603.20.5.4, to protect building occupants from falling glass should breakage occur. The screens shall be capable of supporting the weight of the glass and shall be substantially supported below and installed within four inches (102 mm) of the glass. The screens shall be constructed of a noncombustible material not thinner than No. 12 B & S Gage (0.0808 inch) with a mesh not larger than one inch (25 mm by 25 mm). In a corrosive atmosphere, structurally equivalent non-corrosive atmosphere, structurally equivalent non-corrosive screening materials shall be used. Where used in multiple-layer glazing systems as the bottom glass layer over the walking surface, heat-strengthened glass, fully tempered glass and wired glass shall be equipped with screening that conforms to the requirements specified for monolithic glazing systems.

3603.20.5.4 Exceptions: In monolithic and multiple-layer sloped glazing systems, the following exceptions apply:

1. Fully tempered glass installed without protective screens where glazed between intervening floors at a slope of 30 degrees (0.52 rad) or less from the vertical plane shall have the highest point of the glass ten feet (3048 mm) or less above the walking surface.
2. Screens are not required below any glazing material, including annealed glass, where the walking surface below the glazing material is permanently protected from the risk of falling glass or the area below the glazing material is not a walking surface.
3. Any glazing material, including annealed glass, is permitted to be installed without screens in the sloped glazing systems of detached greenhouses, provided that the height of the greenhouse at the ridge does not exceed 20 feet (6096 mm) above grade. Greenhouse frames shall be noncombustible if the height of the sloped glazing exceeds 20 feet (6096 mm) above grade.
4. Screens shall not be required where fully tempered glass ***or laminated glass with a 15 mil polyvinyl butyral interlayer*** is used as single glazing or as both panes in an insulating glass unit, and all of the following conditions are met:
   a. Each pane of glass is 16 square feet (1.5 m^2) or less in area;
   b. The highest point of the glass is 12 feet (3658 mm) or less above any walking surface or other area having access thereto; and
   c. The glass thickness is $^3/_{16}$ inch (5 mm) or less.

3603.20.5.5 Curbs for skylights. All unit skylights installed in a roof with a pitch flatter than three units vertical in 12 units horizontal (25% slope) shall be mounted on a curb extending at least four inches (102 mm) above the plane of the roof.

780 CMR 3603.21 ENERGY CONSERVATION REQUIREMENTS

3603.21.1 General: All one and two family detatched buildings shall comply with the comprehensive energy requirements set forth in 780 CMR *Appendix J*.

780 CMR 3603.22 PROTECTION AGAINST DECAY AND TERMITES

3603.22.1 Required Protection: Where protection of wood members is required by 780 CMR 3603.22, protection shall be provided against decay or termite damage by the use of naturally durable or preservative-treated wood as required by 780 CMR 3603.22.

3603.22.2 Naturally durable wood: The term "naturally durable wood" refers to the heartwood of the following species with the exception that an occasional piece with corner sapwood is permitted if 90% or more of the width of each side on which it occurs is heartwood

Decay resistant: Redwood, cedar, black locust and black walnut.

Termite resistant: Redwood and Eastern red cedar

3603.22.3 Preservative-treated wood:

3603.22.3.1 Preservative-treated wood: The term "preservative-treated wood" refers to wood (including plywood) pressure treated with preservatives, that conforms to retention, penetration and other requirements applicable to the species, product, treatment and conditions of use in AWPA C1, C2, C9, C15, C18, C20, C22, C23, C24, C27 and C28 listed in ***Appendix A***. Preservatives shall conform to AWPA P1/P13, P2, P5, P8 and P9 listed in ***Appendix A***. Lumber and plywood in wood foundation systems shall conform to 780 CMR 1808.3.

3603.22.3.2 Identification: All piles, poles, lumber and plywood which are required to be preservative-treated shall bear the quality mark of an approved agency that maintains continuing supervision, testing and inspection over the quality of the product. Quality-control inspection agencies for preservative-treated wood shall be certified as to competency and performance by an approved organization. Said mark shall include the following information in a legible format: identification of the inspection agency; the standard to which the product is treated; the identification of the treating plant; and the purpose for which the product has been treated. The mark shall be permanently affixed to each piece unless specifically waived by the building official.

3603.22.3.3 Moisture content: Where wood that is pressure treated with a water-borne preservative is used in enclosed locations where drying in service cannot readily occur, such wood shall be at a moisture content of 19% or less before being covered with insulation, interior wall finish, floor covering or other material.

3603.22.3.4 Fasteners: Fasteners for preservative-treated wood shall be of hot-dipped, zinc-coated, galvanized stainless steel, silicon bronze, copper or other corrosion-resistant materials. Fasteners for wood foundations shall be as required in AFPA TR7 listed in ***Appendix A***.

3603.22.4 Wood used above ground: Wood installed above ground in the locations specified in 780 CMR 3603.22.4.1 through 3603.22.4.6 shall be naturally durable wood or preservative-treated wood treated by water-borne preservatives, and shall be treated in accordance with AWPA C2 or C9 listed in ***Appendix A*** for above-ground use.

3603.22.4.1 Joists and girders: Where wood joists or the bottom of a wood structural floor without joists are closer than 18 inches (457 mm), or wood girders are closer than 12 inches (305 mm), to the exposed ground in crawl spaces or unexcavated areas located within the perimeter of the building foundation, the floor assembly (including posts, girders, joists and subfloor) shall be of approved naturally durable or preservative-treated wood.

3603.22.4.2 Framing: All wood framing members, including wood sheathing, which rest on exterior foundation walls and are less than eight inches (203 mm) from exposed earth shall be of approved naturally durable or preservative-treated wood.

3603.22.4.3 Sleepers and sills: Sleepers and sills on a concrete or masonry slab which is in direct contact with earth shall be of approved naturally durable or preservative-treated wood.

3603.22.4.4 Girder ends: The ends of wood girders entering exterior masonry or concrete walls shall be provided with a ½-inch (13 mm) air space on top, sides and end, unless approved naturally durable or preservative-treated wood is used.

3603.22.4.5 Clearance: Clearance between wood siding and earth on the exterior of a building shall not be less than six inches (152 mm) except where siding, sheathing and wall framing are of approved preservative-treated wood.

3603.22.4.6 Posts or columns: Posts or columns supporting permanent structures and supported by a concrete or masonry slab or footing which is in direct contact with the earth shall be of approved naturally durable or preservative-treated wood

Exceptions:

1. Posts or columns which are either exposed to the weather or located in basements or cellars, supported by concrete piers or metal pedestals projecting at least one inch (25 mm) above the slab or deck and six inches (152 mm) above exposed earth, and are separated therefrom by an impervious moisture barrier.
2. Posts or columns in enclosed crawl spaces or unexcavated areas located within the periphery of the building, supported by a concrete pier or metal pedestal at a height greater than eight inches (203 mm) from exposed ground, and are separated therefrom by an impervious moisture barrier.

3603.22.5 Wood in contact with the ground: All wood in contact with the ground (exposed earth) which supports permanent structures that are intended for human occupancy, shall be of approved naturally durable or preservative-treated wood using water-borne preservatives and shall be treated in accordance with AWPA C2 or C9 listed in ***Appendix A*** for ground contact, where used in the locations specified in 780 CMR 3603.22.5.1 and 3603.22.5.2.

Exception: Untreated wood is permitted where such wood is entirely below the ground water level or where continuously submerged in fresh water.

3603.22.5.1 Posts or columns: Sawn posts and columns supporting permanent structures that are intended for human occupancy and which are embedded in concrete in direct contact with the earth or embedded in concrete exposed to the weather, or in direct contact with the earth, shall be of approved preservative-treated wood.

3603.22.5.2 Wood structural members: Wood structural members that support moisture-permeable floors or roofs which are exposed to the weather-such as concrete or masonry slabs-shall be of approved naturally durable or preservative-treated wood unless separated from such floors or roofs by an impervious moisture barrier.

3603.22.6 Exposed Structural Members: Wood members which form the structural supports of buildings, balconies, porches, decks or similar permanent building appurtenances where such members are exposed to the weather without adequate protection from a roof, eave, overhang or other covering to prevent moisture or water accumulation on the surface or at joints between members. Depending on local experience, such members include, but are not limited to, the following:

1. Horizontal members such as girders, joists and decking;
2. Vertical members such as posts, poles and columns; or
3. Both horizontal and vertical members.

3603.22.7 Wood used in retaining walls: Wood installed in retaining or crib walls shall be of approved preservative-treated wood treated in accordance with AWPA C2 or C9 listed in ***Appendix A*** for ground contact, except as indicated in 780 CMR 3603.22.7.1 through 231 l .7.3.

3603.22.7.1 Untreated wood: Where the wall is not more than two feet (610 mm) in height and is separated from the lot line or a permanent building by a minimum distance equal to the height of the wall, the wall is permitted to be of untreated wood.

3603.22.7.2 Naturally durable wood on the lot line: Where a retaining wall or a crib wall is not more than two feet (610 mm) in height and is located on the lot line, approved naturally durable wood is permitted.

3603.22.7.3 Naturally durable wood separated: Where retaining wall or a crib wall is not more than four feet (1219 mm) in height and is separated from the lot line or a permanent building by a minimum distance equal to the height of the wall, approved naturally durable wood is permitted.

780 CMR 3603.23 MANUFACTURED BUILDINGS AND MANUFACTURED HOUSING

3603.23.1 Scope: The design, manufacture, handling, storage, transportation, assembly, construction and/or installation of manufactured buildings and manufactured building components intended for installation in the Commonwealth of Massachusetts shall be in accordance with the provisions of 780 CMR 35. Manufactured buildings or manufactured building components shall not be installed in any jurisdiction of the Commonwealth of Massachusetts unless such manufactured buildings or manufactured building components have been approved and certified in accordance with 780 CMR 35, and the Rules and Regulations for Manufactured Buildings, Manufactured Building Components and Manufactured Housing, 780 CMR R3, as listed in Appendix A.

3603.23.2 Manufactured housing: When constructed in accordance with the Code of Federal Regulations (CFR) Title 24, Chapter XX -

Office of Assistant Secretary for Housing - Federal Housing Commissioner, Department of Housing and Urban Development, Parts 3280, Manufactured home construction and safety standards, and 3282, Manufactured home procedural and enforcement regulations; manufactured housing shall be exempt from the provisions of 780 CMR 3603.23.

Exceptions:

1. Foundations for manufactured housing shall conform to 780 CMR 1806.0;

2. Additions, (when not a manufactured housing unit as defined herein) and site built modifications shall conform to applicable provisions of 780 CMR.

780 CMR 3603.24 SANITATION

3603.24.1 Plumbing and Sanitary Facilities: Every dwelling unit shall be provided with plumbing and sanitary facilities as required by 248 CMR, the Massachusetts State Plumbing and Fuel Gas Code, 105 CMR 410.000, the State Sanitary Code, listed in *Appendix A*. Water closets, baths, showers and bidets shall be located in rooms which provide privacy to the occupant.

3603.24.2 Water supply to fixtures: All plumbing fixtures shall be connected to an approved water supply, in accordance with 248 CMR as listed in *Appendix A*.

3603.24.3 Wastewater: Provision shall be made for disposal of wastewater in accordance with 248 CMR, as listed in *Appendix A*. Wastewater shall be discharged to a sanitary sewer or to an approved private sewage disposal system.

780 CMR 3603.25 ELECTRICAL REQUIREMENTS

3603.25.1 General: Every dwelling unit shall be provided with electrical facilities in accordance with the requirements of 527 CMR 12.00, the Massachusetts State Electrical Code as listed in *Appendix A*.

NON-TEXT PAGE

780 CMR 3604

FOUNDATIONS

780 CMR 3604.1 GENERAL

3604.1.1 General: The provisions of 780 CMR 3604.0 shall control the design and construction of the foundation and foundation spaces for all buildings.

3604.1.2 Requirements: The foundation and its structural elements shall be capable of accommodating all superimposed live, dead and other loads according to ***780 CMR 3603.0*** and all lateral loads in accordance with the provisions of 780 CMR 36. Fills which support footings and foundations shall be designed, installed and tested in accordance with accepted engineering practice. Gravel fill used as footings for wood foundations shall comply with ***780 CMR 3604.3***.

3604.1.3 Drainage: Surface drainage shall be diverted to a storm sewer conveyance or other point of collection or ***away from the foundation system*** to ***avoid*** creating a hazard. ***Finished grades shall be arranged to direct*** surface water away from ***all*** foundation walls. The ***finished*** grade shall ***slope a minimum of ½" per foot for a distance of at least six feet from the face of all foundation walls.***

> **Exception**: Where lot lines, walls, slopes or other physical barriers ***interfere with the drainage requirements of 780 CMR 3604.1.3,*** drains or swales shall be provided to ensure ***that surface drainage is appropriately diverted*** away from the structure.

3604.1.4 Geotechnical evaluation: The ***presumptive*** load-bearing values ***defined*** in Table 3604.1.4 shall be ***used to determine soil bearing capacity for all foundation systems defined herein.***

> **Exception**: ***Where there is evidence that*** expansive, compressible, shifting or other ***unstable*** soil characteristics ***exist,*** the building official shall require soil tests as ***necessary*** to determine the ***bearing capacity of the soil. For the purposes of this section, soils test shall be conducted in accordance with 780 CMR 1802.0.***

3604.1.5 Expansive, compressible or shifting soil: When top or subsoils are expansive, compressible or shifting, such soils shall be removed to a depth and width sufficient to assure stable moisture content in each active zone and shall not be used as fill; or stabilized within each active zone by chemical, dewatering or presaturation.

TABLE 3604.1.4
PRESUMPTIVE LOAD-BEARING VALUES OF FOUNDATION MATERIALS

CLASS OF MATERIAL	LOAD BEARING PRESSURE (pounds per square foot)
Crystalline bedrock	12,000
Sedimentary rock	6,000
Sandy gravel or gravel	5,000
Sand, silty sand, clayey sand, silty gravel and clayey gravel	3,000
Clay, sandy clay, silty clay, and clayey silt	2,000

780 CMR 3604.2 MATERIALS

3604.2.1 Wood foundations: Wood foundation systems shall be designed and installed in accordance with the provisions ***780 CMR 36***.

> **Exception**: The provisions of 780 CMR 3604.2 for wood foundations apply only in the following situations:
>
> 1. Buildings supported by wood foundations shall be limited to no more than two floors and a roof.
> 2. No dimension in a basement room or crawl space area shall exceed the smaller ***dimension*** of either the building width or ***building*** length.

3604.2.1.1 Fasteners: Fasteners used below grade to attach plywood to the exterior side of exterior basement or crawlspace wall studs, or fasteners used in knee wall construction, shall be of Type 304 or 316 stainless steel. Fasteners used above grade to attach plywood, and all lumber-to-lumber fasteners except those used in knee wall construction shall be of Type 304 or 316 stainless steel, silicon bronze, copper, hot-dipped galvanized (zinc coated) steel nails, or hot-tumbled galvanized (zinc coated) steel nails. Electrogalvanized steel nails and galvanized (zinc coated) steel staples shall not be permitted.

3604.2.1.2 Wood treatment: All lumber and plywood shall be treated in accordance with AWPA C22 ***as listed in Appendix A*** and shall be identified as in conformance with such standard by an approved inspection agency. Where lumber and plywood is cut or drilled after treatment, the cut surface shall be field treated with Ammoniacal Copper Arsenate (ACA), Chromated Copper Arsenate (CCA), or Copper Napthenate by repeated brushing, dipping or soaking until the wood absorbs no more preservative. Water-borne preservatives ACA and CCA Types A, B and C shall have a minimum concentration of 3% in solution. Water-borne preservatives FCAP and ACC shall be permitted for field treatment of material originally treated with CCA and ACA water-borne preservatives, and the concentration of FCAP or ACC shall be a minimum of 5% in solution. Copper Napthenate shall be prepared with a solvent conforming to AWPA P5. The preservative concentration shall contain a minimum of 2% copper metal.

3604.2.2 Concrete: Concrete shall have a minimum specified compressive strength as shown in Table ***3604.2.2 and shall be air entrained when subject to freezing and thawing during construction. Total air content (percent by volume of concrete) shall not be less than 5% or more than 7%.***

> **Exception**: Concrete mixtures ***used*** for exterior porches, carport slabs, and steps that will be exposed to freezing and thawing in the presence of deicing chemicals shall ***consist of*** 520 pounds (236 kg) of cement per cubic yard of concrete ***which*** meets ASTM C 150 or C 595 ***as listed in Appendix A***.

TABLE 3604.2.2
MINIMUM SPECIFIED COMPRESSIVE STRENGTH OF CONCRETE

TYPE OR LOCATION OF CONCRETE CONSTRUCTION	MINIMUM SPECIFIED COMPRESSIVE STRENGTH[1] (f'_c)
Basement walls and foundations not exposed to the weather	2,500[2]
Basement slabs and interior slabs on grade, except garage floor slabs	2,500[2]
Basement walls, foundation walls, exterior walls and other vertical concrete work exposed to the weather	3,000[3]
Porches, carport slabs and steps exposed to the weather, and garage floor slabs	3,500[3,4]

For SI: 1 psi = 6.895 kPa.

1. At 28 days psi.
2. Concrete in these locations which may be subject to freezing and thawing during construction shall be air-entrained concrete in accordance with Footnote 3.
3. Concrete shall be air-entrained. Total air content (percent by volume of concrete) shall not be less than 5% or more than 7%.
4. See 780 CMR 3604.2.2. for minimum cement content.

780 CMR 3604.3 FOOTINGS

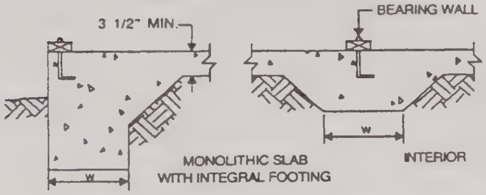
3604.3.1 General: All ***permanent supports of buildings and structures larger than 120 square feet in area or ten feet in height shall extend to minimum of four feet (1.2 m) below finished grade*** except when erected on solid rock or otherwise protected from frost, ***or when the foundation grade is established by a registered design professional and is approved by the building code official***. Minimum sizes for concrete or masonry footings shall be as set forth in Table ***3604.3.1*** and Figure ***3604.3.1a***.

> **3604.3.1.1 Slope**: The top surface of ***all*** footings shall be level. The bottom surface of footings may have a slope not exceeding one unit vertical in ten units horizontal (10% slope). Footings shall be stepped where it is necessary to change the elevation of the top surface of the footing, or where the slope of the bottom surface of the footing will exceed one unit vertical in ten units horizontal (10% slope).

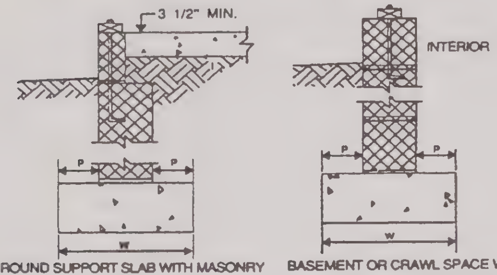
3604.3.2 Footings for wood foundations: Footings for wood foundations shall ***comply*** with the ***applicable provisions of 780 CMR 3604.4, and*** Figures ***3604.3.1b*** and ***3604.3.1c***. ***The gravel base depicted in Figures 3604.3.1b and 3604.3.1c*** shall be washed and well graded. The maximum size stone shall not exceed ¾ inch (19 mm). Gravel shall be free from organic, clayey or silty soils. Sand shall be coarse, not smaller than 1/16-inch (1.6 mm) grains and shall be free from organic, clayey or silty soils. Crushed stone shall have a maximum size of ½ inch (12.7 mm).

3604.3.3 Insulated footings: Footings for heated buildings with slab-on-ground foundations are not required to extend below the frost line when protected from frost by insulating ***methods prescribed by*** Figure ***3604.3.3a*** and Table ***3604.3.3***. Materials used below grade for the purpose of insulating foundations against frost shall be labeled as complying with ASTM C 578.

FIGURE 3604.3.1a
CONCRETE AND MASONRY FOUNDATION DETAILS

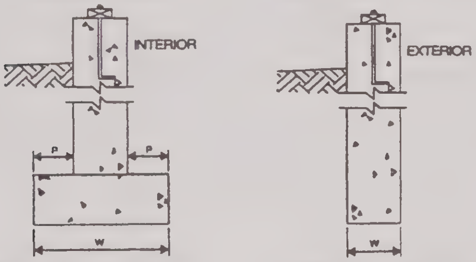


MONOLITHIC SLAB WITH INTEGRAL FOOTING



GROUND SUPPORT SLAB WITH MASONRY WALL AND SPREAD FOOTING

BASEMENT OR CRAWL SPACE WITH MASONRY WALL AND SPREAD FOOTIN G



BASEMENT OR CRAWL SPACE WITH CONCRETE WALL AND SPREAD FOOTING

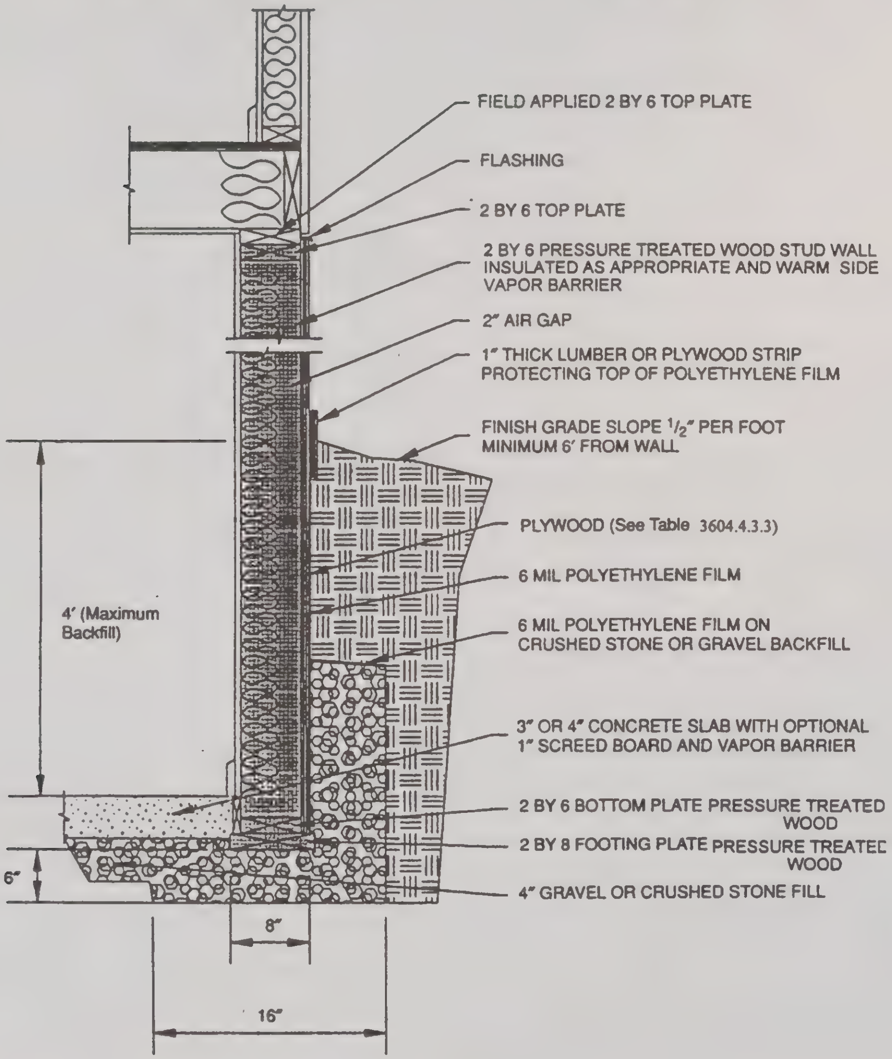
BASEMENT OR CRAWL SPACE WITH FOUNDATION WALL BEARING DIRECTLY ON SOIL

For SI 1 inch = 25.4 mm, 1 foot = 304.8 mm.

NOTES:

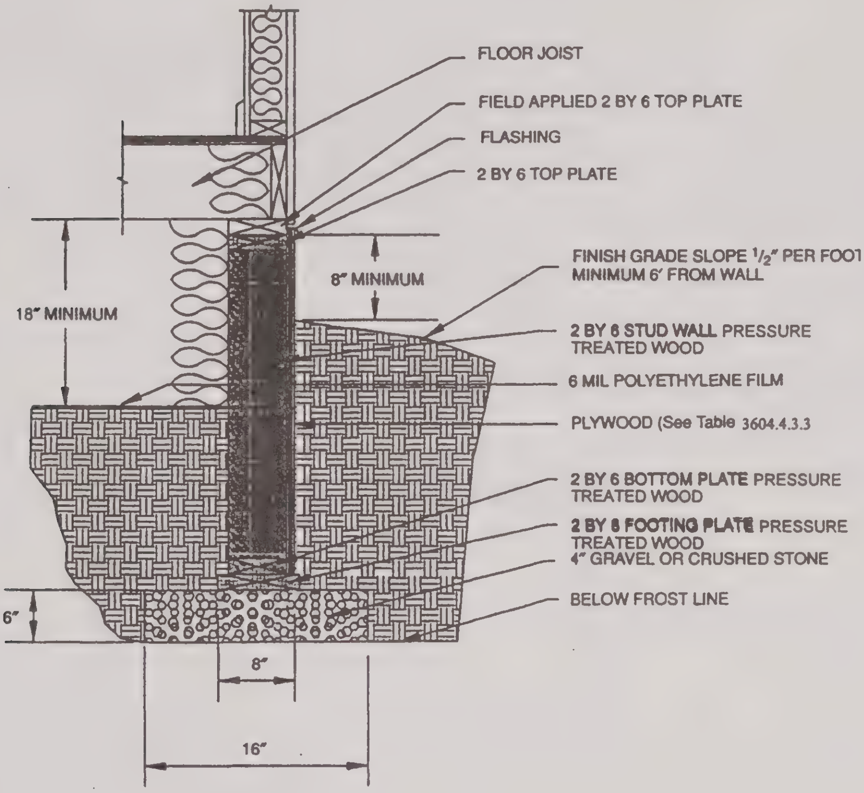
1. Exterior footings shall extend to below the frost line unless otherwise protected against frost heave. In no case shall exterior footings be less than 12 inches below grade.
2. Footing widths (*W*) shall be based on the load-bearing value of the soil in accordance with Table 3604.1.4 or shall be designed in accordance with accepted engineering practice.
3. Spread footings shall be a minimum of six inches thick, and footing projections (*P*) shall be a minimum two inches and shall not exceed the footing thickness.
4. Footings shall be supported on undisturbed natural soil or engineered fill.
5. The sill plate or floor system shall be anchored to the foundation with ½-inch-diameter bolts placed six feet on center and not more than 12 inches from corners. Bolts shall extend a minimum of 15 inches into masonry or eight inches into concrete. Sill plates shall be protected against decay where required by 780 CMR 3603.22. See also 780 CMR 3604.10
6. Pier and column footing sizes shall be based on the tributary load and allowable soil pressure in accordance with Table 3605.2.3.3b.

FIGURE 3604.3.1b
TYPICAL DETAILS FOR WOOD FOUNDATION BASEMENT WALL


FIELD APPLIED 2 BY 6 TOP PLATE
FLASHING
2 BY 6 TOP PLATE
2 BY 6 PRESSURE TREATED WOOD STUD WALL INSULATED AS APPROPRIATE AND WARM SIDE VAPOR BARRIER
2" AIR GAP
1" THICK LUMBER OR PLYWOOD STRIP PROTECTING TOP OF POLYETHYLENE FILM
FINISH GRADE SLOPE 1/2" PER FOOT MINIMUM 6' FROM WALL
PLYWOOD (See Table 3604.4.3.3)
6 MIL POLYETHYLENE FILM
6 MIL POLYETHYLENE FILM ON CRUSHED STONE OR GRAVEL BACKFILL
4' (Maximum Backfill)
3" OR 4" CONCRETE SLAB WITH OPTIONAL 1" SCREED BOARD AND VAPOR BARRIER
2 BY 6 BOTTOM PLATE PRESSURE TREATED WOOD
2 BY 8 FOOTING PLATE PRESSURE TREATED WOOD
4" GRAVEL OR CRUSHED STONE FILL
6"
8"
16"

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm.

FIGURE 3604.3.1c
TYPICAL DETAILS FOR WOOD FOUNDATION CRAWL SPACE WALLS


FLOOR JOIST
FIELD APPLIED 2 BY 6 TOP PLATE
FLASHING
2 BY 6 TOP PLATE
FINISH GRADE SLOPE 1/2" PER FOOT MINIMUM 6' FROM WALL
8" MINIMUM
18" MINIMUM
2 BY 6 STUD WALL PRESSURE TREATED WOOD
6 MIL POLYETHYLENE FILM
PLYWOOD (See Table 3604.4.3.3
2 BY 6 BOTTOM PLATE PRESSURE TREATED WOOD
2 BY 8 FOOTING PLATE PRESSURE TREATED WOOD
4" GRAVEL OR CRUSHED STONE
BELOW FROST LINE
6"
8"
16"

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm.

TABLE 3604.3.1
MINIMUM WIDTH OF CONCRETE OR MASONRY FOOTINGS (inches)

	LOAD-BEARING VALUE OF SOIL (psf)					
	1,500	2,000	2,500	3,000	3,500	4,000
Conventional Wood Frame Construction						
1-story	16	12	10	8	7	6
2-story	19	15	12	10	8	7
3-story	22	17	14	11	10	9
4-inch Brick Veneer over Wood Frame or 8-inch Hollow Concrete Masonry						
1-story	19	15	12	10	8	7
2-story	25	19	15	13	11	10
3-story	31	23	19	16	13	12
8-inch Solid or Fully Grouted Masonry						
1-story	22	17	13	11	10	9
2-story	31	23	19	16	13	12
3-story	40	30	24	20	17	15

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm.

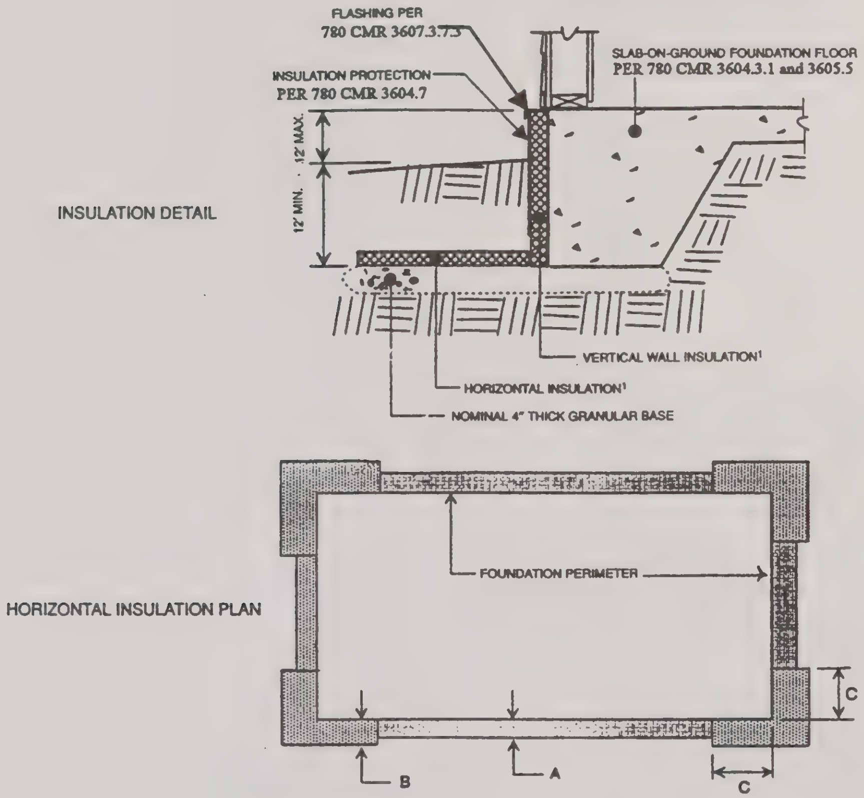
TABLE 3604.3.3
MINIMUM INSULATION REQUIREMENTS FOR FROST-PROTECTED FOOTINGS IN HEATED BUILDINGS

VERTICAL INSULATION *R*-VALUE^{2,4}	HORIZONTAL INSULATION *R*-VALUE^{3,5}		HORIZONTAL INSULATION DIMENSIONS PER FIGURE 3604.3.3 (inches)		
	along walls	at corners	A	B	C
4.5	NR	NR	NR	NR	NR

For SI: 1 inch = 25.4 mm, °F = 1.8°C + 32

1. Insulation requirements are for protection against frost damage in heated buildings. Greater values may be required to meet energy conservation standards. Interpolation between values is permissable.
2. Air Freezing Index values based on 1,500 °F days.
3. Insulation materials shall provide the stated minimum R-values under the long term exposure to moist, below-ground conditions in freezing climates. The following R-values shall be used to determine insulation thickness required for this application: Type II expanded polystyrene - 2.4R per inch; Type IV extruded polystyrene - 4.5R per inch; Type VI extruded polystyrene - 4.5R per inch; Type IX expanded polystyrene - 3.2R per inch; Type X extruded polystyrene - 4.5R per inch. NR indicates that insulation is not required.
4. Vertical insulation shall be expanded polystyrene insulation or extruded insulation.
5. Horizontal insulation shall be extruded polystyrene insulation.

FIGURE 3604.3.3a
INSULATION PLACEMENT FOR FROST-PROTECTED FOOTINGS IN HEATED BUILDINGS


FLASHING PER 780 CMR 3607.3.7.3
INSULATION PROTECTION PER 780 CMR 3604.7
SLAB-ON-GROUND FOUNDATION FLOOR PER 780 CMR 3604.3.1 and 3605.5
12" MAX.
12" MIN.
INSULATION DETAIL
VERTICAL WALL INSULATION¹
HORIZONTAL INSULATION¹
NOMINAL 4" THICK GRANULAR BASE
HORIZONTAL INSULATION PLAN
FOUNDATION PERIMETER
A
B
C
C

For SI: 1 inch = 25.4 mm.

1. See table 3604.3.3 for required dimensions and *R*-values for vertical and horizontal insulation.

780 CMR 3604.4 FOUNDATION WALLS

3604.4.1 Concrete and masonry foundation walls: Foundation walls shall be constructed in accordance with the provisions of 780 CMR 3604.4 or in accordance with ACI 318, ACI 318.1, NCMA TR68-A or ACI 530/ASCE 5/TMS 402 ***as listed in Appendix A,*** or other approved structural systems.

3604.4.1.1 Masonry and concrete wall construction: Masonry and concrete foundation walls shall be constructed as ***in accordance with*** Table ***3604.4.1.1a***.

Exception: Where unstable soil conditions exist or where the foundation extends to or below the seasonal high groundwater table, foundation walls shall be constructed in accordance with Table ***3604.4.1.1b***.

3604.4.1.2 Design: Foundation walls subject to more pressure than would be exerted by backfill having an equivalent fluid weight of 30 pounds per cubic foot (141 kN/m^3) shall be designed in accordance with accepted engineering practice by a registered professional engineer or registered architect.

3604.4.1.3 Grade Clearance: Foundation walls shall extend at least ***eight inches*** above the finished grade adjacent to the foundation at all points.

Exception: Where masonry veneer is used, foundation walls shall extend a minimum of four inches (102 mm) above the finished grade.

TABLE 3604.4.1.1a
MINIMUM THICKNESS AND ALLOWABLE DEPTH OF UNBALANCED FILL FOR UNREINFORCED MASONRY AND CONCRETE FOUNDATION WALLS[1,2] WHERE UNSTABLE SOIL OR GROUNDWATER CONDITIONS DO NOT EXIST

FOUNDATION WALL CONSTRUCTION	NOMINAL THICKNESS[3] (inches)	MAXIMUM DEPTH OF UNBALANCED FILL[1] (feet)
Masonry of Hollow Units, Ungrouted	8 10 12	4 5 6
Masonry of Solid Units	6 8 10 12	3 5 6 7
Masonry of Hollow or Solid Units, Fully Grouted	8 10 12	7 8 8
Plain Concrete	6[4] 8 10 12	6 7 8 8
Rubble Stone Masonry	16	8
Masonry of hollow units reinforced vertically, with No. 4 bars and grout at 24 inches on center. Bars located not less than 4½ inches from pressure side of wall.	8	7

For SI: 1 inch = 25.4 mm; 1 foot = 304.8 mm.

1. Unbalanced fill is the difference in height of the exterior and interior finish ground levels. Where an interior concrete slab is provided, the unbalanced fill shall be measured from the exterior finish ground level to the top of the interior concrete slab.
2. The height between lateral supports shall not exceed eight feet.
3. The actual thickness shall not be more than ½ inch less than the required nominal thickness specified in the table.
4. Six-inch plain concrete walls shall be formed on both sides.

TABLE 3604.4.1.1 b
REQUIREMENTS FOR MASONRY OR CONCRETE FOUNDATION WALLS SUBJECTED TO NO MORE PRESSURE THAN WOULD BE EXERTED BY BACKFILL HAVING AN EQUIVALENT FLUID WEIGHT OF 30 POUNDS PER CUBIC FOOT OR SUBJECTED TO UNSTABLE SOIL CONDITIONS

MATERIAL TYPE	HEIGHT OF UNBALANCED FILL IN FEET[1]	LENGTH OF WALL BETWEEN SUPPORTING MASONRY OR CONCRETE WALLS IN FEET	MINIMUM[2] WALL THICKNESS IN INCHES[3]	REQUIRED REINFORCING	
				Horizintal Bar in Upper 12 inches of wall	Size and Spacing of Vertical Bars
Hollow Masonry	4 or less	unlimited	8	not required	not required
	more than 4	design required	design required	design required	design required
Concrete or Solid Masonry[4]	4 or less	unlimited	8	noot required	not required
	more than 4	less tha 8	8	2-No. 3	No. 3 @ 18" o.c.
	8 or less	8 to 10	8	2-No. 4	No. 3 @ 18" o.c.
	8 or less	10 to 12	8	2-No. 5	No. 3 @ 18" o.c.
	more than 8	design required	design required	design required	design required

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 pound per cubic foot (pcf) = 0.1572 kN/m^3.

1 Backfilling shall not be commenced until after the wall is anchored to the floor or adequate bracing is in place.

2. Thickness of concrete walls may be six inches, provided reinforcing is placed not less than one inch or more than two inches from the face of the wall not against the earth.

3. The actual thickness shall not be more than ½ inch less than the required thickness specified in the table.

4. Solid masonry shall include solid brick or concrete units and hollow masonry units with all cells grouted.

3604.4.1.3.1 Backfill placement: Backfill adjacent to the wall shall not be placed until the wall has sufficient strength ***in accordance with 780 CMR 3604.2.2*** and has been anchored to the floor, or has been sufficiently braced to prevent damage by the backfill.

> **Exception**: Such bracing is not required for walls ***retaining*** less than three feet (914 mm) of unbalanced backfill.

3604.4.2 Design required: Foundation walls subject to more lateral pressure than would be exerted by backfill consisting of freely draining sands and gravel classified as Group I according to the United States Soil Classification System or soils having an equivalent fluid weight of greater than 30 pounds per cubic foot (4.72 kN/m^3) shall be designed in accordance with accepted engineering practices by a registered professional engineer or registered architect.

3604.4.3 Wood foundation walls: Wood foundation walls shall be constructed in accordance with the provisions of *780 CMR 3604.4.3.1* through *3604.4.3.5* and with the details shown in Figures *3604.3.1b* and *3604.3.1c*.

3604.4.3.1 Wood grade: All load-bearing lumber and plywood shall conform to applicable standards or grading rules and be identified by a grade mark or certificate of inspection issued by an approved lumber or plywood grading or inspection bureau or agency. Lumber shall conform to DOC PS 20-94.

TABLE 3604.4.3.3
PLYWOOD GRADE AND THICKNESS FOR WOOD FOUNDATION CONSTRUCTION
(30 pcf equivalent-fluid weight soil pressure)

HEIGHT OF FILL (inches)	STUD SPACING (inches)	FACE GRAIN ACROSS STUDS			FACE GRAIN PARALLEL TO STUDS		
		Grade[1]	Minimum Thickness	Identification Index	Grade[1]	Minimum Thickness[2,3]	Identification Index
24	12	B	15/32	32/16	A	15/32	32/16
					B	15/32[3]	32/16
	16	B	15/32	32/16	A	15/32[3]	32/16
					B	19/32[3] (4,5 ply)	40/20
36	12	B	15/32	32/16	A	15/32	32/16
					B	15/32[3] (4,5 ply)	32/16
					B	19/32 (4, 5 ply)	40/20
	16	B	15/32[3]	32/16	A	19/32	40/20
					B	23/32	48/24
48	12	B	15/32	32/16	A	15/32[3]	32/16
					B	19/32[3] (4, 5 ply)	40/20
	16	B	19/32	40/20	A	19/32[3]	40/20
					A	23/32	48/24

For SI: 1 inch = 25.4 mm, 1 pound per cubic foot = 0.1572 kN/m^3.

1. Plywood shall be of the following minimum grades in accordance with DOC PS1 or DOC PS2:
   (i) DOC PS 1 Plywood grades marked:
      a. Structural I C-D (Exposure 1)
      b. C-D (Exposure 1)
   (ii) DOC PS 2 Plywood grades marked:
      a. Structural I Sheathing (Exposure 1)
      b. Sheathing (Exposure 1)
   (iii) Where a major portion of the wall is exposed above ground and a better appearance is desired, the following plywood grades marked Exterior are suitable:
      a. Structural I A-C, Structural I B-C or Structural I C-C (Plugged) in accordance with DOC PS 1
      b. A-C Group 1, B-C Group 1, C-C (Plugged) Group 1 or MDO Group 1 in accordance with DOC PS 1
      c. Single Floor in accordance with DOC PS 2
2. Minimum thickness 15/32 inch, except crawl space sheathing may be ⅜ inch for face grain across studs 16 inches on center and maximum two foot depth of unequal fill.
3. For this fill height, thickness and grade combination, panels which are continuous over less stud spacings require blocking 16 inches above the bottom plate. Offset adjacent blocks and fasten through corrosion-resistant nails at each end.

3604.4.3.2 Stud size: The studs used in foundation walls shall be two by six (51 by 153) members. When spaced 16 inches on center, a wood species with an F_b value of not less than 1,250 psi (8612 kPa) as listed in Table *3605.2.3.1d* shall be used. When spaced 12 inches (305 mm) on center, an F_b of not less than 875 (6029 kPa) shall be required.

3604.4.3.3 Height of backfill: The height of backfill against a foundation wall shall not exceed four feet (1219 mm). When the height of fill is more than 12 inches (305 mm) above the interior grade of a crawl space or floor of a basement, the thickness of the plywood sheathing shall meet the requirements of Table ***3604.4.3.3***.

3604.4.3.4 Backfilling: Wood foundation walls shall not be backfilled until the basement floor and first floor have been constructed or the walls have been braced. For crawl space construction, backfill or bracing shall be installed on the interior of the walls prior to placing backfill on the exterior.

3604.4.3.5 Drainage and dampproofing: Wood foundation basements shall be drained and dampproofed in accordance with 780 CMR 3604.5 and 780 CMR 3604.6, respectively.

780 CMR 3604.5 FOUNDATION DRAINAGE

3604.5.1 Concrete or masonry foundations: Drains shall be provided around all concrete or masonry foundations enclosing habitable or usable spaces located below grade. Drainage tiles, gravel or crushed stone drains, perforated pipe or other approved systems or materials shall be installed at or below the area to be protected and shall discharge by gravity or mechanical means into an approved drainage system. Gravel or crushed stone drains shall extend at least one foot (305 mm) beyond the outside edge of the footing and six inches (153 mm) above the top of the footing and be covered with an approved filter membrane material. The top of open joints of drain tiles shall be protected with strips of building paper, and the drainage tiles or perforated pipe shall be placed on a minimum of two inches (51 mm) of washed gravel or crushed rock at least one sieve size larger than the tile joint opening or perforation and covered with not less than six inches (153 mm) of the same material.

Exception: A drainage system is not required when the foundation is installed on well-drained ground or sand-gravel mixture soils according to the Unified Soil Classification System, Group I Soils, as detailed Table ***3604.5.1***.

TABLE 3604.5.1
PROPERTIES OF SOILS CLASSIFIED ACCORDING TO THE UNIFIED SOIL CLASSIFICATION SYSTEM

SOIL GROUP	UNIFIED SOIL CALSSIFICA-TION SYSTEM SYMBOL	SOIL DESCRIPTION	DRAINAGE CHARACTERISTICS[1]	FROST HEAVE POTENTIAL	VOLUME CHANGE POTENTIAL EXPANSION
Group I	GW	Well-graded gravels, gravel sand mixtures, little or no fines	Good	Low	Low
	GP	Poorly graded gravels or gravel sand mixtures, little or no fines	Good	Low	Low
	SW	Well-graded sands, gravelly sands, little or no fines	Good	Low	Low
	SP	Poorly graded sands or gravelly sands, little or no fines	Good	Low	Low
	GM	Silty gravels, gravel-sand-silt mixtures	Good	Medium	Low
	SM	Silty sand, sand-silt mixtures	Good	Medium	Low
Group II	GC	Clayey gravels, gravel-sand-clay mixtures	Medium	Medium	Low
	SC	Clayey sands, sand-clay mixture	Medium	Medium	Low
	ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity.	Medium	High	Low
	CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays	Medium	Medium	Medium[2] to Low
Group III	CH	Inorganic clays or high plasticity, fat clays	Poor	Medium	High[2]
	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts	Poor	High	High
Group IV	OL	Organic silts and organic silty clays of low plasticity.	Poor	Medium	Medium
	OH	Organic clays of medium to high plasticity, organic silts.	Unsatisfactory	Medium	High
	Pt	Peat and other highly organic soils.	Unsatisfactory	Medium	High

For SI: 1 inch = 25.4 mm.

1 The percolation rate for good drainage is over four inches per hour, medium drainage is two to four inches per hour, and poor is less than two inches per hour.

2. Dangerous expansion might occur if these two soil types are dry but subject to future wetting.

3604.5.2 Wood foundations: Wood foundations enclosing habitable or usable spaces located below grade shall be adequately drained in accordance with *780 CMR 3604.5.2.1* through *3604.5.2.3*.

3604.5.2.1 Base: A porous layer of gravel, crushed stone or coarse sand shall be placed to a minimum thickness of four inches (102 mm) under the basement floor. Provision shall be made for automatic draining of this layer and the gravel or crushed stone wall footings.

3604.5.2.2 Moisture barrier: A six-mil-thick (0.15 mm) polyethylene moisture barrier shall be applied over the porous layer with the basement floor constructed over the polyethylene.

3604.5.2.3 Drainage system: In other than Group I soils, a sump shall be provided to drain the porous layer and footings. The sump shall be at least 24 inches (610 mm) in diameter or 20 inches square (0.0129 m^2), shall extend at least 24 inches (610 mm) below the bottom of the basement floor and shall be capable of positive gravity or mechanical drainage to remove any accumulated water. The drainage system shall discharge into an approved sewer system or to daylight.

780 CMR 3604.6 FOUNDATION WATERPROOFING AND DAMPPROOFING

3604.6.1 Concrete and masonry foundation dampproofing: Except where required to be waterproofed by *780 CMR 3604.6.2*, foundation walls enclosing habitable or storage space shall be dampproofed from the top of the footing to the finished grade. Masonry walls shall be dampproofed by applying not less than ⅜ inch (9.5 mm) portland cement parging to the exterior of the wall. The parging shall be covered with a bituminous coating, three pounds per square yard (1.63 kg/m^2) of acrylic modified cement, ⅛-inch (3.2 mm) coat of surface-bonding mortar complying with ASTM C 887 or any material permitted for waterproofing in *780 CMR 3604.6.2*. Concrete walls shall be dampproofed by applying any one of the above listed dampproofing materials or any one of the waterproofing materials listed in *780 CMR 3604.6.2* to the exterior of the wall.

3604.6.2 Concrete and masonry foundation waterproofing: In areas where a high water table or other severe soil-water conditions are known to exist, exterior foundation walls enclosing habitable or storage space shall be waterproofed with a membrane extending from the top of the footing to the finished grade. The membrane shall consist of two-ply hot-mopped felts, 55 pound (25 kg) roll roofing, 6-mil (0. 15 mm) polyvinyl chloride, six-mil (0.15 mm) polyethylene or 40-mil (1 mm) polymer-modified asphalt. The joints in the membrane shall be lapped and sealed with an adhesive compatible with the waterproofing membrane.

3604.6.3 Dampproofing for wood foundations: Wood foundations enclosing habitable or usable spaces located below grade shall be dampproofed in accordance with *780 CMR 3604.6.3.1* through *3604.6.3.5*.

3604.6.3.1 Panel joint sealed: Plywood panel joints in the foundation walls shall be sealed full length with a caulking compound capable of producing a moistureproof seal under the conditions of temperature and moisture content at which it will be applied and used.

3604.6.3.2 Below grade moisture barrier: A six-mil-thick (0.15 mm) polyethylene film shall be applied over the below-grade portion of exterior foundation walls prior to backfilling. Joints in the polyethylene film shall be lapped six inches (153 mm) and sealed with adhesive. The top edge of the polyethylene film shall be bonded to the sheathing to form a seal. Film areas at grade level shall be protected from mechanical damage and exposure by a pressure preservatively treated lumber or plywood strip attached to the wall several inches above finish grade level and extending approximately nine inches (229 mm) below grade. The joint between the strip and the wall shall be caulked full length prior to fastening the strip to the wall. Other coverings appropriate to the architectural treatment may also be used. The polyethylene film shall extend down to the bottom of the wood footing plate but shall not overlap or extend into the gravel or crushed stone footing.

3604.6.3.3 Porous fill: The space between the excavation and the foundation wall shall be backfilled with the same material used for footings, up to a height of one foot (305 mm) above the footing for well-drained sites, or ½ the total backfill height for poorly drained sites. The porous fill shall be covered with strips of 30-pound (13.6 kg) asphalt paper or six-mil (0.15 mm) polyethylene to permit water seepage while avoiding infiltration of fine soils.

3604.6.3.4 Backfill: The remainder of the excavated area shall be backfilled with the same type of soil as was removed during the excavation. The backfill ***shall*** be placed in six- to eight-inch (153 mm to 203 mm) layers and compacted to consolidate the fill.

3604.6.3.5 Final grading: ***Finished grades shall conform to 780 CMR 3604.1.3.***

780 CMR 3604.7 FOUNDATION INSULATION

3604.7.1 Protection of exposed foundation insulation: Foundation walls and the edges of slab-on-ground floors with exterior applied insulation shall have a rigid, opaque and weather-resistant protective covering to prevent the degradation of thermal performance. The protective covering shall cover the exposed insulation and extend to a minimum of six inches (153 mm) below grade.

780 CMR 3604.8 COLUMNS

3604.8.1 Wood column protection: Wood columns shall be protected against decay as set forth in ***780 CMR 3603.22***.

3604.8.2 Steel column protection: All surfaces (inside and outside) of steel columns shall be given a shop coat of rust-inhibitive paint, except for corrosion-resistant steel and steel treated with coatings to provide corrosion resistance.

3604.8.3 Structural requirements: ***All*** columns shall be restrained to prevent lateral displacement. Wood columns shall not be less in nominal size than four inches by four inches (102 mm by 102 mm) and steel columns shall not be less than three-inch-diameter (76 mm) standard pipe or approved equivalent.

780 CMR 3604.9 CRAWL SPACE

3604.9.1 Ventilation: The space between the bottom of the floor joists and the earth under any building (except such space as is occupied by a basement or cellar) shall be provided with ***a sufficient number of*** ventilation openings through foundation walls or exterior walls. ***Such*** ventilation openings shall be covered with corrosion-resistant wire mesh, the least dimension ***shall not exceed*** ⅛ inch (3.2 mm). The minimum net area of ventilation openings shall not be less than one square foot for each 150 square feet (0.67 m^2 for each 100 m^2) of crawl space area. One such ventilating opening shall be within three feet (914 mm) of each corner of the building, ***and the ventilation openings shall be positioned to provide cross ventilation.***

Exceptions:

1. The total area of ventilation openings may be reduced to 1/1,500 of the under-floor area where the ground surface is treated with an approved vapor barrier material and one such ventilation opening is within three feet (914 mm) of each corner of said buildings. The vents may have operable louvers.
2. ***If design conditions warrants,*** ventilation openings may be omitted on one side.
3. Under-floor spaces used as supply plenums for distribution of heated and cooled air shall comply with the requirements of ***780 CMR 3621 as applicable.***
4. Ventilation openings may be omitted when continuously operated mechanical ventilation is provided at a rate of 1.0 cfm for each 50 square feet (1.02 L/s for each 10 m^2) of crawl space floor area and ground surface is covered with an approved vapor barrier material.

3604.9.2 Access: An access crawl hole 18 inches by 24 inches (457 mm by 610 mm) shall be provided to the under-floor space.

3604.9.3 Removal of debris: The under-floor grade shall be cleaned of all vegetation and organic material. All wood forms used for placing concrete shall be removed before a building is occupied or used for any purpose.

3604.9.4 Finished grade: The finished grade of under-floor surface may be located at the bottom of the footings; however. where there is evidence that the groundwater table can rise to within six inches (153 mm) of the finished floor at the building perimeter or where there is evidence that the surface water does not readily drain from the building site, the grade in the under-floor space shall be as high as the outside finished grade. unless an approved drainage system is provided.

3604.10 Foundation anchorage: Wall sill plates, minimum of two-inch by four-inch members, shall be sized and anchored to foundation walls or piers and at intermediate intervals as required to resist wind uplift. Foundation anchorage shall be provided by the installation of anchor bolts or other approved anchoring method. Anchor bolts shall be of a minimum diameter of ½ inch. The bolts shall be embedded in foundations to a depth of not less than eight inches (203 mm) of cast-in-place concrete, and not less than 15 inches (381 mm) in grouted unit masonry. There shall be a minimum of two anchor bolts per section of plate and anchor bolts shall be placed 12 inches (305 mm) from the end of each section of plate, with intermediate bolts spaced a maximum of six feet (1829 mm) on center for one- and two-story buildings and not more than four feet (1219 mm) on center for buildings over two stories in height.

NON-TEXT PAGE

FLOORS

780 CMR 3605.1 GENERAL

3605.1.1 Application: The provisions of 780 CMR 3605.0 shall control the design and construction of the floors for all buildings. The use of materials or methods of construction not specified in 780 CMR 3605.0 accomplishing the purposes intended by 780 CMR 36 and approved by the building official in accordance with 780 CMR 109 shall be accepted as complying with 780 CMR 36.

3605.1.2 Requirements: Floor construction shall be capable of ***supporting*** all loads imposed according to ***780 CMR 3603.1*** and transmitting the resulting loads to other supporting elements.

780 CMR 3605.2 FLOOR FRAMING

3605.2.1 General: Load-bearing dimension lumber for joists, beams and girders shall conform to DOC PS 20, ***as listed in Appendix A,*** and to other applicable standards or grading rules and shall be so identified by a grade mark or certificate of inspection issued by an approved agency. The grade mark or certificate shall provide adequate information to determine *Fb*, the allowable stress in bending, and *E*, the modulus of elasticity.

Exception: Use of Native Lumber shall be allowed in accordance with 780 CMR 2303.0.

3605.2.1.1 Preservative-treated lumber: Preservative-treated dimension lumber shall also be identified by the quality mark of an approved agency.

3605.2.1.2 Blocking and subflooring: Blocking shall be a minimum of Utility grade lumber. Subflooring may be a minimum of Utility Grade lumber or No. 4 Common grade boards.

3605.2.1.3 End jointed lumber: Approved end-jointed lumber may be used interchangeably with solid-sawn members of the same species and grade.

3605.2.2 Design and construction: Floors of wood construction shall be designed and constructed in accordance with the provisions of 780 CMR 3605.2 and Figure ***3605.2.2***.

3605.2.3 Allowable spans: Joists, girders and floor sheathing shall comply with ***780 CMR 3605.2.3.1*** through ***3605.2.3.3*** and ***780 CMR 3605.3***.

3605.2.3.1 Allowable joist spans: The clear span of floor joists shall not exceed the values set forth in Tables ***3605.2.3.1a***, ***3605.2.3.1b*** and ***3605.2.3.1c***. The modulus of elasticity, E, and the actual stress in bending, F_b, shown in the tables shall not exceed the values specified in Tables ***3605.2.3.1d*** and ***3605.2.3.1e*** listed at the end of 780 CMR 3605.2. The values for F_b, specified as "repetitive member use" may be used when floor joists are spaced not more than 24 inches (610 mm) on center.

3605.2.3.2 Joists under bearing partitions: Joists under parallel bearing partitions shall be doubled or a beam of adequate size to support the load shall be provided. Double joists which are separated to permit the installation of piping or vents shall be ***provided with*** solid blocking spaced not more than four feet (1219 mm) on center.

3605.2.3.3 Allowable girder spans: The allowable spans of girders shall not exceed the values set forth in Tables ***3605.2.3.3a*** and ***3605.2.3.3b***.

3605.2.4 Bearing: The ends of ***all*** joists, beams or girders shall have not less than 1½ inches (38 mm) of bearing on wood or metal and not less than three inches (76 mm) on masonry except where supported on a one-inch-by-four-inch (25 mm by 102 mm) ribbon strip and nailed to the adjacent stud or ***shall be supported by*** the use of approved joist hangers.

3605.2.4.1 Floor systems: Joists ***that are framed from opposite sides and extend over a*** bearing support shall be tied together by lapping ***the ends of each*** joist a minimum of three inches (76 mm), or with a wood or metal splice ***plate***, or ***shall be secured by overlapping the floor sheathing at least three inches (76 mm) beyond the end of each floor joist***, or by other approved methods.

3605.2.4.2 Joist framing: Joists framing into the side of a wood girder shall be supported by approved framing anchors or on ledger strips ***measuring*** not less than nominal two inches by two inches (51 mm by 51 mm).

3605.2.5 Lateral restraint at supports: Joists shall be supported laterally at the points of support by full-depth solid blocking not less than two inch (51 mm) ***nominal*** thickness; or by attachment to a header, band or rim joist, or to an adjoining stud; or shall be otherwise provided with lateral support to prevent rotation.

3605.2.5.1 Bridging: Joists having a depth-to-thickness ratio exceeding 6:1 based on nominal dimensions shall be supported laterally by solid blocking, diagonal bridging (wood or metal), or a continuous one-inch-by-three-inch (25 mm by 76 mm) strip ***set perpendicularly*** across the bottom of joists ***and appropriately nailed***. ***Bridging shall be installed*** at intervals not exceeding ***eight*** feet (2438 mm).

Exception: Cantilevered joists shall be laterally braced at points of support.

3605.2.6 Cutting and notching: It shall be unlawful to notch, cut or pierce wood beams, joists, rafters or studs in excess of the limitations specified in 780 CMR 3605.2.6, unless proven safe by structural analysis or suitably reinforced to transmit all calculated *loads.*

3605.2.6.1 Drilling and notches: Notches in the top or bottom of joists shall not exceed one-sixth of the depth of the joist, ***shall not be longer than one-third the depth of the member*** and shall not be located in the middle third of the span. ***Notch depth at the ends of the member*** shall not exceed one-fourth the joist depth.

Exceptions:

1. A notch over the support is permitted to extend the full width of the support.

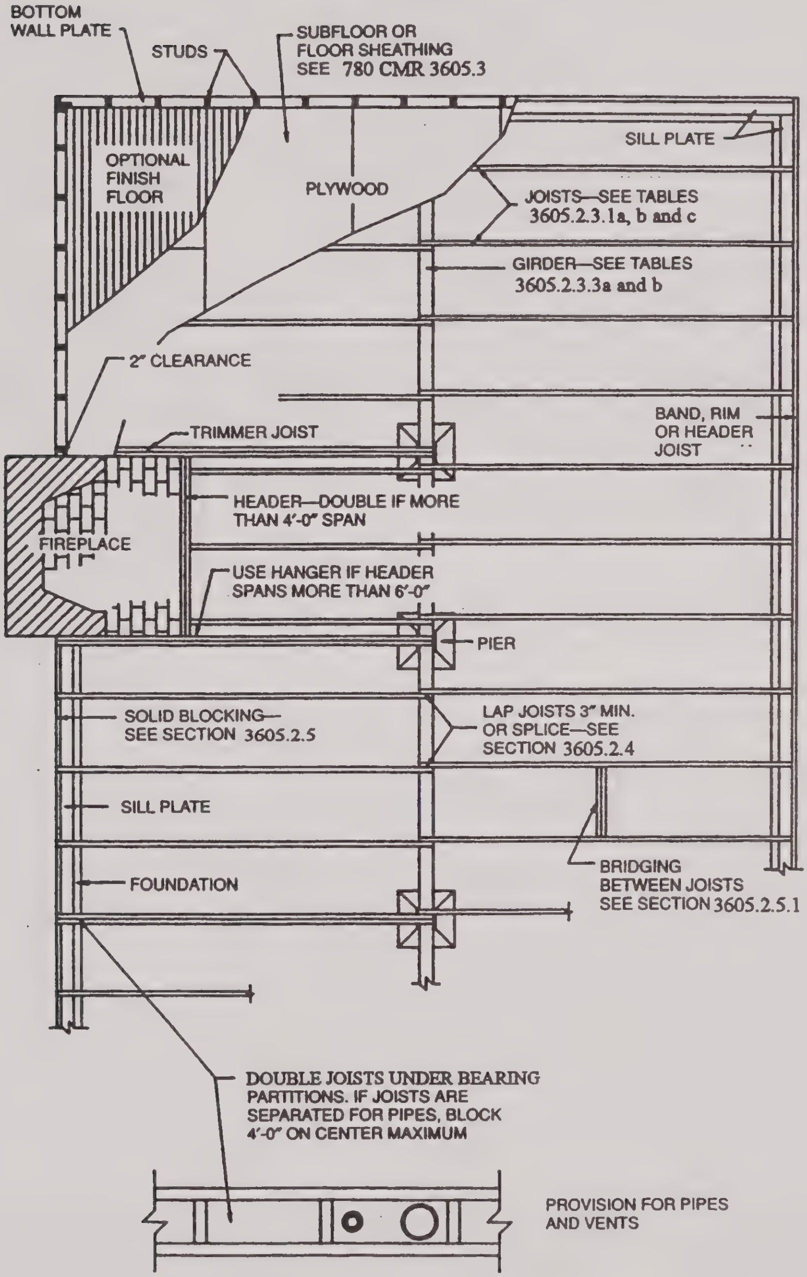
2. Notches on cantilevered portions of the member are permitted to extend the full length of the cantilever if the strength and deflection of the cantilever is calculated based on the reduced member section.

3. The tension side of beams, joists and rafters which are four inches or greater in nominal thickness, shall not be notched, except at ends of members.

3605.2.7 Holes: Holes drilled, bored ***or cut*** into joists shall ***not be closer than*** two inches (51 mm) to the top or bottom of the joists, ***or to any other hole located in the joist. Where the joist is notched, the hole shall not be closer than two inches to the notch. The*** diameter ***of the hole*** shall not exceed one-third the depth of the joist.

3605.2.8 Fastening: Floor framing shall be nailed in accordance with Table ***3606.2.3a***. Where posts and beam or girder construction is used to support floor framing, positive connections shall be provided to ensure against uplift and lateral displacement.

FIGURE 3605.2.2
FLOOR CONSTRUCTION


BOTTOM WALL PLATE
STUDS
SUBFLOOR OR FLOOR SHEATHING SEE 780 CMR 3605.3
OPTIONAL FINISH FLOOR
PLYWOOD
SILL PLATE
JOISTS—SEE TABLES 3605.2.3.1a, b and c
GIRDER—SEE TABLES 3605.2.3.3a and b
2" CLEARANCE
TRIMMER JOIST
BAND, RIM OR HEADER JOIST
HEADER—DOUBLE IF MORE THAN 4'-0" SPAN
FIREPLACE
USE HANGER IF HEADER SPANS MORE THAN 6'-0"
PIER
SOLID BLOCKING— SEE SECTION 3605.2.5
LAP JOISTS 3" MIN. OR SPLICE—SEE SECTION 3605.2.4
SILL PLATE
FOUNDATION
BRIDGING BETWEEN JOISTS SEE SECTION 3605.2.5.1
DOUBLE JOISTS UNDER BEARING PARTITIONS. IF JOISTS ARE SEPARATED FOR PIPES, BLOCK 4'-0" ON CENTER MAXIMUM
PROVISION FOR PIPES AND VENTS

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm.

TABLE 3605.2.3.1a
ALLOWABLE SPANS FOR FLOOR JOISTS
40 Lbs. per Sq. Ft. Live Load

(All rooms except those used for sleeping areas and attic floors.)

DESIGN CRITERIA:

Strength- Live load of 40 lbs. per sq. ft. plus dead load of 10 lbs. per sq. ft. determines the fiber stress value shown.

Deflection-For 40 lbs. per sq. ft. live load. Limited to span in inches divided by 360.

HOW TO USE TABLES: Enter table with span of joists (upper figure in each square). Determine size and spacing (first column) based on stress grade (lower figure in each square) and modulus of elasticity (top row) of lumber to be used.

Joist Size and Spacing		MODULUS OF ELASTICITY, "E," IN 1,000,000 PSI																		
inches	inches	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0	2.2	2.4
2 X 6	12.0	6-9	7-3	7-9	8-2	8-6	8-10	9-2	9-6	9-9	10-0	10-3	10-6	10-9	10-11	11-2	11-4	11-7	11-11	12-3
		450	520	590	660	720	780	830	890	940	990	1,040	1,090	1,140	1,190	1,230	1,280	1,320	1,410	1,490
	16.0	6-2	6-7	7-0	7-5	7-9	8-0	8-4	8-7	8-10	9-1	9-4	9-6	9-9	9-11	10-2	10-4	10-6	10-10	11-2
		500	580	650	720	790	860	920	980	1,040	1,090	1,150	1,200	1,250	1,310	1,360	1,410	1,460	1,550	1,640
	24.0	5-4	5-9	6-2	6-6	6-9	7-0	7-3	7-6	7-9	7-11	8-2	8-4	8-6	8-8	8-10	9-0	9-2	9-6	9-9
		570	660	750	830	900	980	1,050	1,120	1,190	1,250	1,310	1,380	1,440	1,500	1,550	1,610	1,670	1,780	1,880
2 X 8	12.0	8-11	9-7	10-2	10-9	11-3	11-8	12-1	12-6	12-10	13-2	13-6	13-10	14-2	14-5	14-8	15-0	15-3	15-9	16-2
		450	520	590	660	720	780	830	890	940	990	1,040	1,090	1,140	1,190	1,230	1,280	1,320	1,410	1,490
	16.0	8-1	8-9	9-3	9-9	10-2	10-7	11-0	11-4	11-8	12-0	12-3	12-7	12-10	13-1	13-4	13-7	13-10	14-3	14-8
		500	580	650	720	790	850	920	980	1,040	1,090	1,150	1,200	1,250	1,310	1,360	1,410	1,460	1,550	1,640
	24.0	7-1	7-7	8-1	8-6	8-11	9-3	9-7	9-11	10-2	10-6	10-9	11-0	11-3	11-5	11-8	11-11	12-1	12-6	12-10
		570	660	750	830	900	980	1,050	1,120	1,190	1,250	1,310	1,380	1,440	1,500	1,550	1,610	1,670	1,780	1,880
2 X 10	12.0	11-4	12-3	13-0	13-8	14-4	14-11	15-5	15-11	16-5	16-10	17-3	17-8	18-0	18-5	18-9	19-1	19-5	20-1	20-8
		450	520	590	660	720	780	830	890	940	990	1,040	1,090	1,140	1,190	1,230	1,280	1,320	1,410	1,490
	16.0	10-4	11-1	11-10	12-5	13-0	13-6	14-0	14-6	14-11	15-3	15-8	16-0	16-5	16-9	17-0	17-4	17-8	18-3	18-9
		500	580	650	720	790	850	920	980	1,040	1,090	1,150	1,200	1,250	1,310	1,360	1,410	1,460	1,550	1,640
	24.0	9-0	9-9	10-4	10-10	11-4	11-10	12-3	12-8	13-0	13-4	13-8	14-0	14-4	14-7	14-11	15-2	15-5	15-11	16-5
		570	660	750	830	900	980	1,050	1,120	1,190	1,250	1,310	1,380	1,440	1,500	1,550	1,610	1,670	1,780	1,880
2 X 12	12.0	13-10	14-11	15-10	16-8	17-5	18-1	18-9	19-4	19-11	20-6	21-0	21-6	21-11	22-5	22-10	23-3	23-7	24-5	25-1
		450	520	590	660	720	780	830	890	940	990	1,040	1,090	1,140	1,190	1,230	1,280	1,320	1,410	1,490
	16.0	12-7	13-6	14-4	15-2	15-10	16-5	17-0	17-7	18-1	18-7	19-1	19-6	19-11	20-4	20-9	21-1	21-6	22-2	22-10
		500	580	650	720	790	860	920	980	1,040	1,090	1,150	1,200	1,250	1,310	1,360	1,410	1,460	1,550	1,640
	24.0	11-10	11-10	12-7	13-3	13-10	14-4	14-11	15-4	15-10	16-3	16-8	17-0	17-5	17-9	18-1	18-5	18-9	19-4	19-11
		570	660	750	830	900	980	1,050	1,120	1,190	1,250	1,310	1,380	1,440	1,500	1,550	1,610	1,670	1,780	1,880

For SI: 1 inch = 25.4 mm, 1 pound per square inch = 6.895 kPa, 1 pound per square foot = 0.0479 kN/m^2.

NOTE: The extreme fiber stress in bending, "F_b," in pounds per square inch is shown below each span.

TABLE 3605.2.3.1b
ALLOWABLE SPANS FOR FLOOR JOISTS
30 Lbs per Sq. Ft. Live Load

(All rooms used for sleeping areas and attic floors.)

DESIGN CRITERIA:

Strength- 10 lbs. per sq. ft. dead load plus 30 lbs. per sq. live load determines fiber stress value shown.
Deflection-For 30 lbs. per sq. ft. live load. Limited to span in inches divided by 360.

HOW TO USE TABLES: Enter table with span of joists (Upper figure in each square). Determine size and spacing(first column) based on stress grade (lower figure in each square) and modulus of elasticity (top row) of lumber to be used.

Joist Size and Spacing		MODULUS OF ELASTICITY, "E," IN 1,000,000 PSI																		
inches	inches	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0	2.2	2.4
2 X 6	12.0	7-5 440	8-0 510	8-6 570	8-11 640	9-4 700	9-9 750	10-1 810	10-5 860	10-9 910	11-0 960	11-3 1,010	11-7 1,060	11-10 1,100	12-0 1,150	12-3 1,200	12-6 1,240	12-9 1,280	13-1 1,370	13-6 1,450
	16.0	6-9 480	7-3 560	7-9 630	8-2 700	8-6 770	8-10 830	9-2 890	9-6 950	9-9 1,000	10-0 1,060	10-3 1,110	10-6 1,160	10-9 1,220	10-11 1,270	11-2 1,320	11-4 1,360	11-7 1,410	11-11 1,500	12-3 1,590
	24.0	5-11 550	6-4 640	6-9 720	7-1 800	7-5 880	7-9 950	8-0 1,020	8-3 1,080	8-6 1,150	8-9 1,210	8-11 1,270	9-2 1,330	9-4 1,390	9-7 1,450	9-9 1,510	9-11 1,560	10-1 1,620	10-5 1,720	10-9 1,820
2 X 8	12.0	9-10 440	10-7 510	11-3 570	11-10 640	12-4 700	12-10 750	13-4 810	13-9 860	14-2 910	14-6 960	14-11 1,010	15-3 1,060	15-7 1,100	15-10 1,150	16-2 1,200	16-6 1,240	16-9 1,280	17-4 1,370	17-10 1,450
	16.0	8-11 480	9-7 560	10-2 630	10-9 700	11-3 770	11-8 830	12-1 890	12-6 950	12-10 1,000	13-2 1,060	13-6 1,110	13-10 1,160	14-2 1,220	14-5 1,270	14-8 1,320	15-0 1,360	15-3 1,410	15-9 1,500	16-2 1,590
	24.0	7-9 550	8-5 640	8-11 720	9-4 800	9-10 880	10-2 950	10-7 1,020	10-11 1,080	11-3 1,150	11-6 1,210	11-10 1,270	12-1 1,330	12-4 1,390	12-7 1,450	12-10 1,510	13-1 1,560	13-4 1,620	13-9 1,720	14-2 1,820
2 X 10	12.0	12-6 440	13-6 510	14-4 570	15-1 640	15-9 700	16-5 750	17-0 810	17-6 860	18-0 910	18-6 960	19-0 1,010	19-5 1,060	19-10 1,100	20-3 1,150	20-8 1,200	21-0 1,240	21-5 1,280	22-1 1,370	22-9 1,450
	16.0	11-4 480	12-3 560	13-0 630	13-8 700	14-4 770	14-11 830	15-5 890	15-11 950	16-5 1,000	16-10 1,060	17-3 1,110	17-8 1,160	18-0 1,220	18-5 1,270	18-9 1,320	19-1 1,360	19-5 1,410	20-1 1,500	20-8 1,590
	24.0	9-11 550	10-8 640	11-4 720	11-11 800	12-6 880	13-0 950	13-6 1,020	13-11 1,080	14-4 1,150	14-8 1,210	15-1 1,270	15-5 1,330	15-9 1,390	16-1 1,450	16-5 1,510	16-8 1,560	17-0 1,620	17-6 1,720	18-0 1,820
2 X 12	12.0	15-2 440	16-5 510	17-5 570	18-4 640	19-2 700	19-11 750	20-8 810	21-4 860	21-11 910	22-6 960	23-1 1,010	23-7 1,060	24-2 1,100	24-8 1,150	25-1 1,200	25-7 1,240	26-0 1,280	26-10 1,370	27-8 1,450
	16.0	13-10 480	14-11 560	15-10 630	16-8 700	17-5 770	18-1 830	18-9 890	19-4 950	19-11 1,000	20-6 1,060	21-0 1,110	21-6 1,160	21-11 1,220	22-5 1,270	22-10 1,320	23-3 1,360	23-7 1,410	24-5 1,500	25-1 1,590
	24.0	12-1 550	13-0 640	13-10 720	14-7 800	15-2 880	15-10 950	16-5 1,020	16-11 1,080	17-5 1,150	17-11 1,210	18-4 1,270	18-9 1,330	19-2 1,390	19-7 1,450	19-11 1,510	20-3 1,560	20-8 1,620	21-4 1,720	21-11 1,820

For **SI:** 1 inch = 25.4 mm, 1 pound per square inch = 6.895 kPa, 1 pound per square foot = 0.0479 kN/m^2.

NOTE: The extreme fiber stress in bending, "F_b," in pounds per square inch is shown below each span.

TABLE 3605.2.3.1c
ALLOWABLE SPANS FOR FLOOR JOISTS IN DECKS AND BALCONIES
60 Lbs per square foot Live Load

DESIGN CRITERIA:
Strength - Live load of 60 psf plus dead load of 10 psf determines the fiber stress value shown.
Deflection - Live load of 60 psf. Limited to span (in inches) divided by 360.

HOW TO USE TABLES:
Enter table with span of joists (upper figure in each square). Determine size and spacing (first column) based on stress grade (lower figure in each square) and modulus of elasticity (top row) of lumber to be used.

Joist Size and Spacing inches		MODULUS OF ELASTICITY, "E", IN 1,000,000 PSI																
		0.8	0.9	1.0	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0	2.1	2.2	2.3	2.4
2x6	12	7-5 767	7-9 830	8-0 890	8-3 949	8-6 1005	8-9 1061	8-11 1114	9-2 1167	9-4 1218	9-7 1268	9-9 1317	9-11 1366	10-1 1413	10-3 1460	10-5 1506	10-7 1551	10-9 1596
	16	6-9 844	7-0 913	7-3 980	7-6 1044	7-9 1107	7-11 1167	8-2 1226	8-4 1284	8-6 1341	8-8 1396	8-10 1450	9-0 1503	9-2 1556	9-4 1607	9-6 1658	9-7 1707	9-9 1757
	24	5-11 967	6-2 1046	6-4 1122	6-7 1195	6-9 1267	6-11 1336	7-1 1404	7-3 1470	7-5 1535	7-7 1598	7-9 1660	7-10 1721	8-0 1781	8-2 1848	8-3 1897	8-5 1995	8-6 2011
2x8	12	9-10 767	10-2 830	10-7 890	10-11 949	11-3 1005	11-6 1061	11-10 1114	12-1 1167	12-4 1218	12-7 1268	12-10 1317	13-1 1366	13-4 1413	13-6 1460	13-9 1506	13-11 1551	14-2 1596
	16	8-11 844	9-3 913	9-7 980	9-11 1044	10-2 1107	10-6 1167	10-9 1226	11-0 1284	11-3 1341	11-5 1396	11-8 1450	11-11 1503	12-1 1556	12-3 1607	12-6 1658	12-8 1707	12-10 1757
	24	7-9 967	8-1 1046	8-5 1122	8-8 1195	8-11 1267	9-2 1336	9-4 1404	9-7 1470	9-10 1535	10-0 1598	10-2 1660	10-5 1721	10-7 1781	10-9 1848	10-11 1897	11-1 1995	11-3 2011
2x10	12	12-6 767	13-0 830	13-6 890	13-11 949	14-4 1005	14-8 1061	15-1 1114	15-5 1167	15-9 1218	16-1 1268	16-5 1317	16-8 1366	17-0 1413	17-3 1460	17-6 1506	17-9 1551	18-0 1596
	16	11-4 844	11-10 913	12-3 980	12-8 1044	13-0 1107	13-4 1167	13-8 1226	14-0 1284	14-4 1341	14-7 1396	14-11 1450	15-2 1503	15-5 1556	15-8 1607	15-11 1658	16-2 1707	16-5 1757
	24	9-11 967	10-4 1046	10-8 1122	11-0 1195	11-4 1267	11-8 1336	11-11 1404	12-3 1470	12-6 1535	12-9 1598	13-0 1660	13-3 1721	13-6 1781	13-8 1848	13-11 1897	14-1 1995	14-4 2011
2x12	12	15-2 767	15-10 830	16-5 890	16-11 949	17-5 1005	17-11 1061	18-4 1114	18-9 1167	19-2 1218	19-7 1268	19-11 1317	20-3 1366	20-8 1413	21-0 1460	21-4 1506	21-7 1551	21-11 1596
	16	13-10 844	14-4 913	14-11 980	15-4 1044	15-10 1107	16-3 1167	16-8 1226	17-0 1284	17-5 1341	17-9 1396	18-1 1450	18-5 1503	18-9 1556	19-1 1607	19-4 1658	19-8 1707	19-11 1757
	24	12-1 967	12-7 1046	13-0 1122	13-5 1195	13-10 1267	14-2 1336	14-7 1404	14-11 1470	15-2 1535	15-6 1598	15-10 1660	16-1 1721	16-5 1781	16-8 1848	16-11 1897	17-2 1995	17-5 2011

For SI: 1 inch = 25.4 mm, 1 pound per square inch = 6.895 kPa, 1 pound per square foot = 0.0479 kN/m^2.
NOTE: The extreme fiber stress in bending, "F_b," in pounds per square inch is shown below each span.

TABLE 3605.2.3.1d
DESIGN VALUES FOR DIMENSION LUMBER - VISUAL GRADING

These "F_b" values are for use where three or more repetitive members are spaced not more than 24 inches apart. For wider spacing or for single or double member headers or beams, the "F_b" values should be reduced 13%. Values for surfaced dry or surfaced green lumber apply at 19% maximum moisture content in use.

SPECIES AND GRADE	SIZE	NORMAL DURATION	DESIGN VALUE IN BENDING "Fb"		MODULUS OF ELASTICITY "E"	GRADING RULES AGENCY
			Snow Loading	7-Day Loading		
ASPEN						
Select Structural	2" x 4"	1,510	1,735	1,885	1,100,000	Northeastern Lumber Manufacturers Association Northern Softwood Lumber Bureau Western Wood Products Association (See Footnotes 1 and 2)
No. 1		1,080	1,240	1,350	1,100,000	
No. 2		1,035	1,190	1,295	1,000,000	
No. 3		605	695	755	900,000	
Stud		600	690	750	900,000	
Construction		805	925	1,005	900,000	
Standard		430	495	540	900,000	
Utility		200	230	250	800,000	
Select Structural	2"x 6"	1,310	1,505	1,635	1,100,000	
No. 1		935	1,075	1,170	1,100,000	
No. 2		895	1,030	1,120	1,000,000	
No. 3		525	600	655	900,000	
Stud		545	630	685	900,000	
Select Structural	2" x 8"	1,210	1,390	1,510	1,100,000	
No. 1		865	990	1,080	1,100,000	
No. 2		830	950	1,035	1,000,000	
No. 3		485	555	605	900,000	
Select Structural	2"x 10"	1,105	1,275	1,385	1,100,000	
No. 1		790	910	990	1,100,000	
No. 2		760	875	950	1,000,000	
No. 3		445	510	555	900,000	
Select Structural	2" x 12"	1,005	1,155	1,260	1,100,000	
No. 1		720	825	900	1,100,000	
No. 2		690	795	865	1,000,000	
No. 3		405	465	505	900,000	
BEECH - BIRCH - HICKORY						
Select Structural	2" x 4"	2,500	2,875	3,125	1,700,000	Northeastern Lumber Manufacturers Association (See Footnotes 1 and 2)
No. 1		1,810	2,085	2,265	1,600,000	
No. 2		1,725	1,985	2,155	1,500,000	
No. 3		990	1,140	1,240	1,300,000	
Stud		980	1,125	1,225	1,300,000	
Construction		1,325	1,520	1,655	1,400,000	
Standard		750	860	935	1,300,000	
Utility		345	395	430	1,200,000	
Select Structural	2"x 6"	2,170	2,495	2,710	1,700,000	
No. 1		1,570	1,805	1,960	1,600,000	
No. 2		1,495	1,720	1,870	1,500,000	
No. 3		860	990	1,075	1,300,000	
Stud		890	1,025	1,115	1,300,000	
Select Structural	2" x 8"	2,000	2,300	2,500	1,700,000	
No. 1		1,450	1,665	1,810	1,600,000	
No. 2		1,380	1,585	1,725	1,500,000	
No. 3		795	915	990	1,300,000	
Select Structural	2"x 10"	1,835	2,110	2,295	1,700,000	
No. 1		1,330	1,525	1,660	1,600,000	
No. 2		1,265	1,455	1,580	1,500,000	
No. 3		725	835	910	1,300,000	
Select Structural	2" x 12"	1,670	1,920	2,085	1,700,000	
No. 1		1,210	1,390	1,510	1,600,000	
No. 2		1,150	1,325	1,440	1,500,000	
No 3		660	760	825	1,300,000	

TABLE 3605.2.3.1d - continued
DESIGN VALUES FOR DIMENSION LUMBER - VISUAL GRADING

SPECIES AND GRADE	SIZE	NORMAL DURATION	DESIGN VALUE IN BENDING "*Fb*"		MODULUS OF ELASTICITY "E"	GRADING RULES AGENCY
			Snow Loading	7-Day Loading		
COTTONWOOD						
Select Structural	2" x 4"	1,510	1,735	1,885	1,200,000	Northern Softwood Lumber Bureau (See Footnotes 1 and 2)
No. 1		1,080	1,240	1,350	1,200,000	
No. 2		1,080	1,240	1,350	1,100,000	
No. 3		605	695	755	1,100,000	
Stud		600	690	750	1,000,000	
Construction		805	925	1,005	1,000,000	
Standard		460	530	575	900,000	
Utility		200	230	250	900,000	
Select Structural	2"x 6"	1,310	1,505	1,635	1,200,000	
No. 1		935	1,075	1,170	1,200,000	
No. 2		935	1,075	1,170	1,100,000	
No. 3		525	600	655	1,000,000	
Stud		545	630	685	1,000,000	
Select Structural	2" x 8"	1,210	1,390	1,510	1,200,000	
No. 1		865	990	1,080	1,200,000	
No. 2		865	990	1,080	1,100,000	
No. 3		485	555	605	1,000,000	
Select Structural	2"x 10"	1,105	1,275	1,385	1,200,000	
No. 1		790	910	910	1,200,000	
No. 2		790	910	990	1,100,000	
No. 3		445	510	555	1,000,000	
Select Structural	2" x 12"	1,005	1,155	1,260	1,200,000	
No. 1		720	825	900	1,200,000	
No. 2		720	825	900	1,100,000	
No. 3		405	465	505	1,000.000	
DOUGLAS FIR - LARCH						
Select Structural	2" x 4"	2,500	2,875	3,125	1,900,000	West Coast Lumber Inspection Bureau Western Wood Products Association (See Footnotes 1 and 2)
No. 1 & Btr		1,985	2,280	2,480	1,800.000	
No. 1		1,725	1,985	2,155	1,700.000	
No. 2		1,510	1,735	1,885	1,600,000	
No. 3		865	990	1,080	1,400,000	
Stud		855	980	1,065	1,400,000	
Construction		1,150	1,325	1,440	1,500,000	
Standard		635	725	790	1,400,000	
Utility		315	365	395	1,300,000	
Select Structural	2"x 6"	2,170	2,495	2,710	1,900,000	
No. 1 & Btr		1,720	1,975	2,150	1,800,000	
No. 1		1,495	1,720	1,870	1,700,000	
No. 2		1,310	1,505	1,635	1,600,000	
No. 3		750	860	935	1,400,000	
Stud		775	895	970	1,400,000	
Select Structural	2" x 8"	2,000	2,300	2,500	1,900,000	
No. & Btr		1,585	1,825	1,985	1,800,000	
No. 1		1,380	1,585	1,725	1,700,000	
No. 2		1,210	1,390	1,510	1,600,000	
No. 3		690	795	865	1,400,000	

TABLE 3605.2.3.1d - continued
DESIGN VALUES FOR DIMENSION LUMBER - VISUAL GRADING

SPECIES AND GRADE	SIZE	NORMAL DURATION	DESIGN VALUE IN BENDING "*Fb*"		MODULUS OF ELASTICITY "E"	GRADING RULES AGENCY
			Snow Loading	7-Day Loading		
Select Structural	2" x 10"	1,835	2,110	2,295	1,900,000	
No. 1 & Btr		1,455	1,675	1,820	1,800,000	
No. 1		1,265	1,455	1,580	1,700,000	
No. 2		1,105	1,275	1,385	1,600,000	
No. 3		635	725	790	1,400,000	
Select Structural	2' x 12"	1,670	1,920	2,085	1,900,000	
No.1 & Btr		1,325	1,520	1,655	1,800,000	
No.1		1,150	1,325	1,440	1,700,000	
No.2		1,005	1,155	1,260	1,600,000	
No.3		575	660	720	1,400,000	
DOUGLAS FIR - LARCH (NORTH)						
Select Structural	2" x 4"	2,245	2,580	2,805	1,900,000	National Lumber Grades Authority (See Footnotes 1 and 2)
No. 1/ No. 2		1,425	1,635	1,780	1,600,000	
No. 3		820	940	1,025	1,400,000	
Stud		820	945	1,030	1,400,000	
Construction		1,095	1,255	1,365	1,500,000	
Standard		605	695	755	1,400,000	
Utility		290	330	360	1,300,000	
Select Structural	2"x 6"	1,945	2,235	2,430	1,900,000	
No. 1/ No. 2		1,235	1,420	1,540	1,600,000	
No. 3		710	815	890	1,400,000	
Stud		750	860	935	1,400,000	
Select Structural	2" x 8"	1,795	2,065	2,245	1,900,000	
No. 1/ No. 2		1,140	1,310	1,425	1,600,000	
No. 3		655	755	820	1,400,000	
Select Structural	2"x 10"	1,645	1,890	2,055	1,900,000	
No. 1/ No. 2		1,045	1,200	1,305	1,600,000	
No. 3		600	690	750	1,400,000	
Select Structural	2" x 12"	1,495	1,720	1,870	1,900,000	
No. 1/ No. 2		950	1,090	1,185	1,600,000	
No. 3		545	630	685	1,400,000	
DOUGLAS FIR - SOUTH						
Select Structural	2" x 4"	2,245	2,580	2,805	1,400,000	Western WoodProducts Association (See footnotes 1 and 2)
No. 1		1,555	1,785	1,940	1,300,000	
No. 2		1,425	1,635	1,780	1,200,000	
No. 3		820	940	1,025	1,100,000	
Stud		820	945	1,030	1,100,000	
Construction		1,065	1,225	1,330	1,200,000	
Standard		605	695	755	1,100,000	
Utility		290	330	360	1,000,000	
Select Structural	2" x 6"	1,945	2,235	2,430	1,400,000	
No. 1		1,345	1,545	1,680	1,300,000	
No. 2		1,235	1,420	1,540	1,200,000	
No. 3		710	815	890	1,100,000	
Stud		750	860	935	1,100,000	
Select Structural	2" x 8"	1,795	2,065	2,245	1,400,000	
No. 1		1,240	1,430	1,555	1,300,000	
No. 2		1,140	1,310	1,425	1,200,000	
No. 3		655	755	820	1,100,000	

TABLE 3605.2.3.1d - continued
DESIGN VALUES FOR DIMENSION LUMBER - VISUAL GRADING

SPECIES AND GRADE	SIZE	NORMAL DURATION	DESIGN VALUE IN BENDING "*Fb*"		MODULUS OF ELASTICITY "E"	GRADING RULES AGENCY
			Snow Loading	7-Day Loading		
Select Structural	2" x 10"	1,645	1,890	2,055	1,400,000	
No. 1		1,140	1,310	1,425	1,300,000	
No. 2		1,045	1,200	1,305	1,200,000	
No. 3		600	690	750	1.100,000	
Select Structural	2" x 12"	1,495	1,720	1,870	1,400,000	
No. 1		1035	1,190	1,295	1,300,000	
No. 2		950	1,090	1,185	1,200,000	
No. 3		545	630	685	1,100,000	
EASTERN SOFTWOODS						
Select Structural	2" x 4"	2,155	2,480	2,695	1,200,000	Northeastern Lumber Manufacturers Association Northern Softwood Lumber Bureau (See Footnotes 1 and 2)
No. 1		1,335	1,535	1,670	1,100,000	
No. 2		990	1,140	1,240	1,100,000	
No. 3		605	695	755	900,000	
Stud		570	655	710	900,000	
Construction		775	895	970	1,000,000	
Standard		430	495	540	900,000	
Utility		200	230	250	800,000	
Select Structural	2"x 6"	1,870	2,150	2,335	1,200,000	
No. 1		1,160	1,330	1,450	1,100,000	
No. 2		860	990	1,075	1,100,000	
No. 3		525	600	655	900,000	
Stud		520	595	645	900,000	
Select Structural	2" x 8"	1,725	1,985	2,155	1,200,000	
No. 1		1,070	1,230	1,335	1,100,000	
No. 2		795	915	990	1,100,000	
No. 3		485	555	605	900,000	
Select Structural	2"x 10"	1,580	1,820	1,975	1,200,000	
No. 1		980	1,125	1,225	1,100,000	
No. 2		725	835	910	1,100,000	
No. 3		445	510	555	900,000	
Select Structural	2" x 12"	1,440	1,655	1,795	1,200,000	
No. 1		890	1,025	1,115	1,100,000	
No. 2		660	760	825	1,100,000	
No. 3		405	465	505	900,000	

TABLE 3605.2.3.1d - continued
DESIGN VALUES FOR DIMENSION LUMBER - VISUAL GRADING

SPECIES AND GRADE	SIZE	NORMAL DURATION	DESIGN VALUE IN BENDING "*Fb*"		MODULUS OF ELASTICITY "E"	GRADING RULES AGENCY
			Snow Loading	7-Day Loading		
EASTERN WHITE PINE						
Select Structural	2" x 4"	2,155	2,480	2,695	1,200,000	Northeastern Lumber Manufacturers Association Northern Softwood Lumber Bureau (See Footnotes 1 and 2)
No. 1		1,335	1,535	1,670	1,100,000	
No. 2		990	1,140	1,240	1,100,000	
No. 3		605	695	755	900,000	
Stud		570	655	710	900,000	
Construction		775	895	970	1,000,000	
Standard		430	495	540	900,000	
Utility		200	230	250	800,000	
Select Structural	2" x 6"	1,870	2,150	2,335	1,200,000	
No. 1		1,160	1,330	1,450	1,100,000	
No. 2		860	990	1,075	1,100,000	
No. 3		525	600	655	900,000	
Stud		520	595	645	900,000	
Select Structural	2" x 8"	1,725	1,985	2,155	1,200,000	
No. 1		1,070	1,230	1,335	1,100,000	
No. 2		795	915	990	1,100,000	
No. 3		485	555	605	900,000	
Select Structural	2" x 10"	1,580	1,820	1,975	1,200,000	
No. 1		980	1,125	1,225	1,100,000	
No. 2		725	835	910	1,100,000	
No. 3		445	510	555	900,000	
Select Structural	2" x 12"	1,440	1,655	1,795	1,200,000	
No. 1		890	1,025	1,115	1,100,000	
No. 2		660	760	825	1,100,000	
No. 3		405	465	505	900,000	

TABLE 3605.2.3.1d - continued
DESIGN VALUES FOR DIMENSION LUMBER - VISUAL GRADING

SPECIES AND GRADE	SIZE	NORMAL DURATION	DESIGN VALUE IN BENDING "*Fb*"		MODULUS OF ELASTICITY "E"	GRADING RULES AGENCY
			Snow Loading	7-Day Loading		
EASTERN HEMLOCK - TAMARACK						
Select Structural	2" x 4"	2,155	2,480	2,695	1,200,000	Northeastern Lumber Manufacturers Association Northern Softwood Lumber Bureau (See Footnotes 1 and 2)
No. 1		1,335	1,535	1,670	1,100,000	
No. 2		990	1,140	1,240	1,100,000	
No. 3		605	695	755	900,000	
Stud		570	655	710	900,000	
Construction		775	895	970	1,000,000	
Standard		430	495	540	900,000	
Utility		200	230	250	800,000	
Select Steuctural	2" x 6"	1,870	2,150	2,335	1,200,000	
No. 1		1,160	1,330	1,450	1,100,000	
No. 2		860	990	1,075	1,100,000	
No. 3		525	600	655	900,000	
Stud		520	595	645	900,000	
Select Structural	2" x 8"	1,725	1,985	2,155	1,200,000	
No. 1		1,070	1,230	1,335	1,100,000	
No. 2		795	915	990	1,100,000	
No. 3		485	555	605	900,000	
Select Structural	2" x 10"	1,580	1,820	1,975	1,200,000	
No. 1		980	1,125	1,225	1,100,000	
No. 2		725	835	910	1,100,000	
No. 3		445	510	555	900,000	
Select Structural	2" x 12"	1,440	1,655	1795	1,200,000	
No. 1		890	1,025	1115	1,100,000	
No. 2		660	760	825	1,100,000	
No. 4		405	465	505	900,000	
HEM - FIR						
Select Structural	2" x 4"	2,415	2,775	3,020	1,600,000	
No. 1 & Btr		1,810	2,085	2,265	1,500,000	
No. 1		1,640	1,885	2,050	1,500,000	
No. 2		1,465	1,685	1,835	1,300,000	

TABLE 3605.2.3.1d - continued
DESIGN VALUES FOR DIMENSION LUMBER - VISUAL GRADING

SPECIES AND GRADE	SIZE	NORMAL DURATION	DESIGN VALUE IN BENDING "*Fb*"		MODULUS OF ELASTICITY "E"	GRADING RULES AGENCY
			Snow Loading	7-Day Loading		
No. 3	2" x 4"	865	990	1,080	1,200,000	West Coast Lumber Inspection Bureau Western Wood Products Association (See Footnotes 1 and 2)
Stud		855	980	1,065	1,200,000	
Construction		1,120	1,290	1,400	1,300,000	
Standard		635	725	790	1,200,000	
Utility		290	330	360	1,100,000	
Select Structural	2"x 6"	2,095	2,405	2,615	1,600,000	
No. 1 & Btr		1,570	1,805	1,960	1,500,000	
No. 1		1,420	1,635	1,775	1,500,000	
No. 2		1,270	1,460	1,590	1,300,000	
No. 3		750	860	935	1,200,000	
Stud		775	895	970	1,200,000	
Select Structural	2" x 8"	1,930	2,220	2,415	1,600,000	
No. & Btr		1,450	1,665	1,810	1,500,000	
No. 1		1,310	1,510	1,640	1,500,000	
No. 2		1,175	1,350	1,465	1,300,000	
No. 3		690	795	865	1,200,000	
Select Structural	2" x 10"	1,770	2,035	2,215	1,600,000	
No. 1 & Btr		1,330	1,525	1,660	1,500,000	
No. 1		1,200	1,380	1,500	1,500,000	
No. 2		1,075	1,235	1,345	1,300,000	
No. 3		635	725	790	1,200,000	
Select Structural	2" x 12"	1,610	1,850	2,015	1,600,000	
No. 1 & Btr		1,210	1,390	1,510	1,500,000	
No. 1		1,095	1,255	1,365	1,500,000	
No. 2		980	1,125	1,220	1,300,000	
No. 3		575	660	720	1,200,000	
HEM - FIR (NORTH)						
Select Structural	2" x 4"	2,245	2,580	2,805	1,700,000	National Lumber Grades Authority (See Footnotes 1 and 2)
No. 1/ No. 2		1,725	1,985	2,155	1,600,000	
No. 3		990	1,140	1,240	1,400,000	
Stud		980	1,125	1,225	1,400,000	
Construction		1,325	1,520	1,655	1,500,000	
Standard		720	825	900	1,400,000	
Utility		345	395	430	1,300,000	
Select Structural	2"x 6"	1,945	2,235	2,430	1,700,000	
No. 1/ No. 2		1,495	1,720	1,870	1,600,000	
No. 3		860	990	1,075	1,400,000	
Stud		890	1,025	1,115	1,400,000	
Select Structural	2" x 8"	1,795	2,065	2,245	1,700,000	
No. 1/ No. 2		1,380	1,585	1,725	1,600,000	
No. 3		795	915	990	1,400,000	
Select Structural	2"x 10"	1,645	1,890	2,055	1,700,000	
No. 1/ No. 2		1,265	1,455	1,580	1,600,000	
No. 3		725	835	910	1,400,000	

TABLE 3605.2.3.1d - continued
DESIGN VALUES FOR DIMENSION LUMBER - VISUAL GRADING

SPECIES AND GRADE	SIZE	NORMAL DURATION	DESIGN VALUE IN BENDING "*Fb*"		MODULUS OF ELASTICITY "E"	GRADING RULES AGENCY
			Snow Loading	7-Day Loading		
Select Structural	2" x 12"	1,495	1,720	1,870	1,700,000	
No. 1/ No. 2		1,150	1,325	1,440	1,600,000	
No. 3		660	760	825	1,400,000	
MIXED MAPLE						
Select Structural	2" x 4"	1,725	1,985	2,155	1,300,000	Northeastern Lumber Manufacturers Association (See Footnotes 1 and 2)
No. 1		1,250	1,440	1,565	1,200,000	
No. 2		1,210	1,390	1,510	1,100,000	
No. 3		690	795	865	1,000,000	
Stud		695	800	870	1,000,000	
Construction		920	1,060	1,150	1,100,000	
Standard		520	595	645	1,000,000	
Utility		260	300	325	900,000	
Select Structural	2"x 6"	1,495	1,720	1,870	1,300,000	
No. 1		1,085	1,245	1,355	1,200,000	
No. 2		1,045	1,205	1,310	1,100,000	
No. 3		600	690	750	1,000,000	
Stud		635	725	790	1,000,000	
Select Structural	2" x 8"	1,380	1,585	1,725	1,300,000	
No. 1		1,000	1,150	1,250	1,200,000	
No. 2		965	1,110	1,210	1,100,000	
No. 3		550	635	690	1,000,000	
Select Structural	2"x 10"	1,265	1,455	1,580	1,300,000	
No. 1		915	1,055	1,145	1,200,000	
No. 2		885	1,020	1,105	1,100,000	
No. 3		505	580	635	1,000,000	
Select Structural	2" x 12"	1,150	1,325	1,440	1,300,000	
No. 1		835	960	1,040	1,200,000	
No. 2		805	925	1,005	1,100,000	
No. 3		460	530	575	1,000,000	
MIXED OAK						
Select Structural	2" x 4"	1,985	2,280	2,480	1,100,000	Northeastern Lumber Manufacturers Association (See Footnotes 1 and 2)
No. 1		1,425	1,635	1,780	1,000,000	
No. 2		1,380	1,585	1,725	900,000	
No. 3		820	940	1,025	800,000	
Stud		790	910	990	800,000	
Construction		1,065	1,225	1,330	900,000	
Standard		605	695	755	800,000	
Utility		290	330	360	800,000	
Select Structural	2"x 6"	1,720	1,975	2,150	1,100,000	
No. 1		1,235	1,420	1,540	1,000,000	
No. 2		1,195	1,375	1,495	900,000	
No. 3		710	815	890	800,000	
Stud		720	825	900	800,000	
Select Structural	2" x 8"	1,585	1,825	1,985	1,100,000	
No. 1		1,140	1,310	1,425	1,000,000	
No. 2		1,105	1,270	1,380	900,000	
No. 3		655	755	820	800,000	

TABLE 3605.2.3.1d - continued
DESIGN VALUES FOR DIMENSION LUMBER - VISUAL GRADING

SPECIES AND GRADE	SIZE	NORMAL DURATION	DESIGN VALUE IN BENDING "*Fb*"		MODULUS OF ELASTICITY "E"	GRADING RULES AGENCY
			Snow Loading	7-Day Loading		
Select Structural	2"x 10"	1,455	1,675	1,820	1,100,000	Northeastern Lumber Manufacturers Association (See Footnotes 1 and 2)
No. 1		1,045	1,200	1,305	1,000,000	
No. 2		1,010	1,165	1,265	900,000	
No. 3		600	690	750	800,000	
Select Structural	2" x 12"	1,325	1,520	1,655	1,100,000	
No. 1		950	1,090	1,185	1,000,000	
No. 2		920	1,060	1,150	900,000	
No. 3		545	630	685	800,000	
MIXED SOUTHERN PINE						
Select Structural	2" x 4"	2,360	2,710	2,945	1,600,000	Southern Pine Manufacturers Association (See Footnotes 1 and 2)
No. 1		1,670	1,920	2,085	1,500,000	
No. 2		1,495	1,720	1,870	1,400,000	
No. 3		865	990	1,080	1,200,000	
Stud		890	1,025	1,115	1,200,000	
Construction		1,150	1,325	1,440	1,300,000	
Standard		635	725	790	1,200,000	
Utility		315	365	395	1,100,000	
Select Structural	2"x 6"	2,130	2,445	2,660	1,600,000	
No. 1		1,495	1,720	1,870	1,500,000	
No. 2		1,325	1,520	1,655	1,400,000	
No. 3		775	895	970	1,200,000	
Stud		775	895	970	1,200,000	
Select Structural	2" x 8"	2,015	2,315	2,515	1,600,000	
No. 1		1,380	1,585	1,725	1,500,000	
No. 2		1,210	1,390	1,510	1,400,000	
No. 3		720	825	900	1,200,000	
Select Structural	2"x 10"	1,725	1,985	2,155	1,600,000	
No. 1		1,210	1,390	1,510	1,500,000	
No. 2		1,065	1,225	1,330	1,400,000	
No. 3		605	695	755	1,200,000	
Select Structural	2" x 12"	1,610	1,850	2,015	1,600,000	
No. 1		1,120	1,290	1,400	1,500,000	
No. 2		1,005	1,155	1,260	1,400,000	
No. 3		575	660	720	1,200,000	
NORTHERN RED OAK						
Select Structural	2" x 4"	2,415	2,775	3,020	1,400,000	Northeastern Lumber Manufacturers Association (See Footnotes 1 and 2)
No. 1		1,725	1,985	2,155	1,400,000	
No. 2		1,680	1,935	2,100	1,300,000	
No. 3		950	1,090	1,185	1,200,000	
Stud		950	1,090	1,185	1,200,000	
Construction		1,265	1,455	1,580	1,200,000	
Standard		720	825	900	1,100,000	
Utility		345	395	430	1,000,000	
Select Structural	2"x 6"	2,095	2,405	2,615	1,400,000	
No. 1		1,495	1,720	1,870	1,400,000	
No. 2		1,460	1,675	1,820	1,300,000	
No. 3		820	945	1,030	1,200,000	
Stud		865	990	1,080	1,200,000	

TABLE 3605.2.3.1d - continued
DESIGN VALUES FOR DIMENSION LUMBER - VISUAL GRADING

SPECIES AND GRADE	SIZE	NORMAL DURATION	DESIGN VALUE IN BENDING "*Fb*"		MODULUS OF ELASTICITY "E"	GRADING RULES AGENCY
			Snow Loading	7-Day Loading		
Select Structural	2" x 8"	1,930	2,220	2,415	1,400,000	Northeastern Lumber Manufacturers Association (See Footnotes 1 and 2)
No. 1		1,380	1,585	1,725	1,400,000	
No. 2		1,345	1,545	1,680	1,300,000	
No. 3		760	875	950	1,200,000	
Select Structural	2"x 10"	1,770	2,035	2,215	1,400,000	
No. 1		1,265	1,455	1,580	1,400,000	
No. 2		1,235	1,420	1,540	1,300,000	
No. 3		695	800	870	1,200,000	
Select Structural	2" x 12"	1,610	1,850	2,015	1,400,000	
No. 1		1,150	1,325	1,440	1,400,000	
No. 2		1,120	1,290	1,400	1,300,000	
No. 3		635	725	790	1,200,000	
NORTHERN SPECIES						
Select Structural	2" x 4"	1,640	1,885	2,050	1,100,000	National Lumber Grades Authority (See Footnotes 1 and 2)
No. 1/ No. 2		990	1,140	1,240	1,100,000	
No. 3		605	695	755	1,000,000	
Stud		570	655	710	1,000,000	
Construction		775	895	970	1,000,000	
Standard		430	495	540	900,000	
Utility		200	230	250	900,000	
Select Structural	2"x 6"	1,420	1,635	1,775	1,100,000	
No. 1/ No. 2		860	990	1,075	1,100,000	
No. 3		525	600	655	1,000,000	
Stud		520	595	645	1,000,000	
Select Structural	2" x 8"	1,310	1,510	1,640	1,100,000	
No. 1/ No. 2		795	915	990	1,100,000	
No. 3		485	555	605	1,000,000	
Select Structural	2"x 10"	1,200	1,380	1,500	1,100,000	
No. 1/ No. 2		725	835	910	1,100,000	
No. 3		445	510	555	1,000,000	
Select Structural	2" x 12"	1,095	1,255	1,365	1,100,000	
No. 1/ No. 2		660	760	825	1,100,000	
No. 3		405	465	505	1,000,000	
NORTHERN WHITE CEDAR						
Select Structural	2" x 4"	1,335	1,535	1,670	800,000	Northeastern Lumber Manufacturers Association (See Footnotes 1 and 2)
No. 1		990	1,140	1,240	700,000	
No. 2		950	1,090	1,185	700,000	
No. 3		560	645	700	600,000	
Stud		540	620	670	600,000	
Construction		720	825	900	700,000	
Standard		405	465	505	600,000	
Utility		200	230	250	600,000	
Select Structural	2"x 6"	1.160	1,330	1,450	800,000	
No. 1		860	990	1,075	700,000	
No. 2		820	945	1,030	700,000	
No. 3		485	560	605	600,000	
Stud		490	560	610	600,000	

TABLE 3605.2.3.1d - continued
DESIGN VALUES FOR DIMENSION LUMBER - VISUAL GRADING

SPECIES AND GRADE	SIZE	NORMAL DURATION	DESIGN VALUE IN BENDING "*Fb*"		MODULUS OF ELASTICITY "E"	GRADING RULES AGENCY
			Snow Loading	**7-Day Loading**		
Select Structural	2" x 8"	1,070	1,230	1,335	800,000	Northeastern Lumber Manufacturers Association (See Footnotes 1 and 2)
No. 1		795	915	990	700,000	
No. 2		760	875	950	700,000	
No. 3		450	515	560	600,000	
Select Structural	2"x 10"	980	1,125	1,225	800,000	
No. 1		725	835	910	700,000	
No. 2		695	800	870	700,000	
No. 3		410	475	515	600,000	
Select Structural	2" x 12"	890	1,025	1,115	800,000	
No. 1		660	760	825	700,000	
No. 2		635	725	790	700,000	
No. 3		375	430	465	800,000	
RED MAPLE						
Select Structural	2" x 4"	2,245	2,580	2,805	1,700,000	Northeastern Lumber Manufacturers Association (See Footnotes 1 and 2)
No. 1		1,595	1,835	1,995	1,600,000	
No. 2		1,555	1,785	1,940	1,500,000	
No. 3		905	1,040	1,130	1,300,000	
Stud		885	1,020	1,105	1,300,000	
Construction		1,210	1,390	1,510	1,400,000	
Standard		660	760	825	1,300,000	
Utility		315	365	395	1,200,000	
Select Structural	2"x 6"	1,945	2,235	2,430	1,700,000	
No. 1		1,385	1,590	1,730	1,600,000	
No. 2		1,345	1,545	1,680	1,500,000	
No. 3		785	905	980	1,300,000	
Stud		805	925	1,005	1,300,000	
Select Structural	2" x 8"	1,795	2,065	2,245	1,700,000	
No. 1		1,275	1,470	1,595	1,600,000	
No. 2		1,240	1,430	1,555	1,500,000	
No. 3		725	835	905	1,300,000	
Select Structural	2"x 10"	1,645	1,890	2,055	1,700,000	
No. 1		1,170	1,345	1,465	1,600,000	
No. 2		1,140	1,310	1,425	1,500,000	
No. 3		665	765	830	1,300,000	
Select Structural	2" x 12"	1,495	1,720	1,870	1,700,000	
No. 1		1,065	1,225	1,330	1,600,000	
No. 2		1,035	1,150	1,295	1,500,000	
No. 3		605	695	755	1,300,000	
RED OAK						
Select Structural	2" x 4"	1,985	2,280	2,480	1,400,000	Northeastern Lumber Manufacturers Association (See Footnotes 1 and 2)
No. 1		1,425	1,635	1,780	1,300,000	
No. 2		1,380	1,585	1,725	1,200,000	
No. 3		820	940	1,025	1,100,000	
Stud		790	910	990	1,100,000	
Construction		1,065	1,225	1,330	1,200,000	
Standard		605	695	755	1,100,000	
Utility		290	330	360	1,000,000	

TABLE 3605.2.3.1d - continued
DESIGN VALUES FOR DIMENSION LUMBER - VISUAL GRADING

SPECIES AND GRADE	SIZE	NORMAL DURATION	DESIGN VALUE IN BENDING "*Fb*"		MODULUS OF ELASTICITY "E"	GRADING RULES AGENCY
			Snow Loading	7-Day Loading		
Select Structural	2"x 6"	1,720	1,975	2,150	1,400,000	Northeastern Lumber Manufacturers Association (See Footnotes 1 and 2)
No. 1		1,235	1,420	1,540	1,300,000	
No. 2		1,195	1,375	1,495	1,200,000	
No. 3		710	815	890	1,100,000	
Stud		720	825	900	1,100,000	
Select Structural	2" x 8"	1,585	1,825	1,985	1,400,000	
No. 1		1,140	1,310	1,425	1,300,000	
No. 2		1,105	1,270	1,380	1,200,000	
No. 3		655	755	820	1,100,000	
Select Structural	2"x 10"	1,455	1,675	1,820	1,400,000	
No. 1		1,045	1,200	1,305	1,300,000	
No. 2		1,010	1,165	1,265	1,200,000	
No. 3		600	690	750	1,100,000	
Select Structural	2" x 12"	1,325	1,520	1,655	1,400,000	
No. 1		950	1,090	1,185	1,300,000	
No. 2		920	1,060	1,150	1,200,000	
No. 3		545	630	685	1,100,000	
REDWOOD						
Clear Structural	2" x 4"	3,020	3,470	3,775	1,400,000	Redwood Inspection Service (See Footnotes 1 and 2)
Select Structural		2,330	2,680	2,910	1,400,000	
Select Structural, open grain		1,900	2,180	2,370	1,100,000	
No. 1		1,680	1,935	2,100	1,300,000	
No. 1, open grain		1,335	1,535	1,670	1,100,000	
No. 2		1,595	1,835	1,995	1,200,000	
No. 2, open grain		1,250	1,440	1,565	1,000,000	
No. 3		905	1,040	1,130	1,100,000	
No. 3, open grain		735	845	915	900,000	
Stud		725	835	910	900,000	
Construction		950	1,090	1,185	900,000	
Standard		520	595	645	900,000	
Utility		260	300	325	800,000	
Clear Structural	2"x 6"	2,615	3,010	3,270	1,400,000	
Select Structural		2,020	2,320	2,525	1,400,000	
Select Structural, open grain		1,645	1,890	2,055	1,100,000	
No. 1		1,460	1,675	1,820	1,300,000	
No. 1, open grain		1,160	1,330	1,450	1,100,000	
No. 2		1,385	1,590	1,730	1,200,000	
No. 2, open grain		1,085	1,245	1,355	1,000,000	
No. 3		785	905	980	1,100,000	
No. 3, open grain		635	730	795	900,000	
Stud		660	760	825	900,000	
Clear Structural	2" x 8"	2,415	2,775	3,020	1,400,000	
Select Structural		1,865	2,140	2,330	1,400,000	
Select Structural, open grain		1,520	1,745	1,900	1,100,000	
No. 1		1,345	1,545	1,680	1,300,000	
No. 1, open grain		1,070	1,230	1,335	1,100,000	
No. 2		1,275	1,470	1,595	1,203,000	

TABLE 3605.2.3.1d - continued
DESIGN VALUES FOR DIMENSION LUMBER - VISUAL GRADING

SPECIES AND GRADE	SIZE	NORMAL DURATION	DESIGN VALUE IN BENDING "*Fb*"		MODULUS OF ELASTICITY "E"	GRADING RULES AGENCY
			Snow Loading	7-Day Loading		
No. 2, open grain	2"x 8"	1,000	1,150	1,250	1,000,000	Redwood Inspection Service (See Footnotes 1 and 2)
No. 3		725	835	905	1,100,000	
No. 3, open grain		585	675	735	900,000	
Clear Structural	2"x 10"	2,215	2,545	2,765	1,400,000	
Select Structural		1,710	1,965	2,135	1,400,000	
Select Structural, open grain		1,390	1,600	1,740	1,100,000	
No. 1		1,235	1,420	1,540	1,300,000	
No. 1, open grain		980	1,125	1,225	1,100,000	
No. 2		1,170	1,345	1,465	1,200,000	
No. 2, open grain		915	1,055	1,145	1,000,000	
No. 3		665	765	830	1,100,000	
No. 3, open grain		540	620	670	900,000	
Clear Structural	2" x 12"	2,015	2,315	2,515	1,400,000	
Select Structural		1,555	1,785	1,940	1,400,000	
Select Structural, open grain		1,265	1,455	1,580	1,100,000	
No. 1		1,120	1,290	1,400	1,300,000	
No. 1, open grain		890	1,025	1,115	1,100,000	
No. 2		1,065	1,225	1,330	1,200,000	
No. 2, open grain		835	960	1,040	1,000,000	
No. 3		605	695	755	1,100,000	
No. 3, open grain		490	560	610	900,000	
SOUTHERN PINE						
Dense Select Structural	2" x 4"	3,510	4,035	4,385	1,900,000	Southern Pine Inspection Bureau (See Footnotes 1 and 2)
Select Strctural		3,280	3,770	4,095	1,800,000	
Non - Dense Select Structural		3,050	3,505	3,810	1,700,000	
No. 1 Dense		2.300	2,645	2,875	1,800,000	
No. 1		2,130	2,445	2,660	1,700,000	
No. 1 Non - Dense		1,955	2,250	2,445	1,600,000	
No. 2 Dense		1,955	2,250	2,445	1,700,000	
No. 2		1,725	1,985	2,155	1,600,000	
No. 2 Non - Dense		1,555	1,785	1,940	1,400,000	
No. 3		980	1,125	1,220	1,400,000	
Stud		1,005	1,155	1,260	1,400,000	
Constrction		1,265	1,455	1,580	1,500,000	
Standard		720	825	900	1,300,000	
Utility		345	395	430	1,300,000	
Dense Select Structural	2"x 6"	3,105	3,570	3,880	1,900,000	
Select Structural		2,935	3,370	3,665	1,800,000	
Non - Dense Select Structural		2,705	3,110	3,380	1,700,000	
No. 1 Dense		2,015	2,315	2,515	1,800,000	
No. 1		1,900	2,180	2,370	1,700,000	
No. 1 Non - Dense		1,725	1,985	2,155	1,600,000	
No. 2 Dense		1,670	1,920	2,085	1,700,000	
No. 2		1,440	1,655	1,795	1,600,000	
No. 2 Non - Dense		1,325	1,520	1,655	1,400,000	

TABLE 3605.2.3.1d - continued
DESIGN VALUES FOR DIMENSION LUMBER - VISUAL GRADING

SPECIES AND GRADE	SIZE	NORMAL DURATION	DESIGN VALUE IN BENDING "*Fb*"		MODULUS OF ELASTICITY "E"	GRADING RULES AGENCY
			Snow Loading	7-Day Loading		
No. 3	2" x 6"	865	990	1,080	1,400,000	Southern Pine Inspection Bureau (See Footnotes 1 and 2)
Stud		890	1,025	1,115	1,400,000	
Dense Select Structural	2" x 8"	2,820	3,240	3,520	1,900,000	
Select Structural		2,645	3,040	3,305	1,800,000	
Non - Dense Select Structural		2,415	2,775	3,020	1,700,000	
No. 1 Dense		1,900	2,180	2,370	1,800,000	
No. 1		1,725	1,985	2,155	1,700,000	
No. 1 Non - Dense		1,555	1,785	1,940	1,600,000	
No. 2 Dense		1,610	1,850	2,015	1,700,000	
No. 2		1,380	1,585	1,725	1,600,000	
No. 2 Non - Dense		1,265	1,455	1,580	1,400,000	
No. 3		805	925	1,005	1,400,000	
Dense Select Structural	2"x 10"	2,475	2,845	3,090	1,900,000	
Select Structural		2,360	2,710	2,945	1,800,000	
Non - Dense Select Structural		2,130	2,445	2,660	1,700,000	
No. 1 Dense		1,670	1,920	2,085	1,800,000	
No. 1		1,495	1,720	1,870	1,700,000	
No. 1 Non - Dense		1,380	1,585	1,725	1,600,000	
No. 2 Dense		1,380	1,585	1,725	1,700,000	
No. 2		1,210	1,390	1,510	1,600,000	
No. 2 Non - Dense		1,095	1,255	1,365	1,400,000	
No. 3		690	795	865	1,400,000	
Dense Select Structural	2" x 12"	2,360	2,710	2,945	1,900,000	
Select Structural		2,185	2,515	2,730	1,800,000	
Non - Dense Select Structural		2,015	2,315	2,515	1,700,000	
No. 1 Dense		1,555	1,785	1,940	1,800,000	
No. 1		1,440	1,655	1,795	1,700,000	
No. 1 Non - Dense		1,325	1,520	1,655	1,600 000	
No. 2 Dense		1,325	1,520	1,655	1,700,000	
No. 2		1,120	1,290	1,400	1,600,000	
No. 2 Non - Dense		1,035	1,190	1,295	1,400,000	
No. 3		660	760	825	1,400,000	
SPRUCE - PINE - FIR						
Select Structural	2" x 4"	2,155	2,480	2,695	1,500,000	National Lumber Grades Authority (See Footnotes 1 and 2)
No. 1/ No. 2		1,510	1,735	1,885	1,400,000	
No. 3		865	990	1,080	1,200,000	
Stud		855	980	1,065	1,200,000	
Construction		1,120	1,290	1,400	1,300,000	
Standard		635	725	790	1,200,000	
Utility		290	330	360	1,100,000	
Select Structural	2"x 6"	1,870	2,150	2.335	1,500,000	
No. 1/ No. 2		1,310	1,505	1.635	1,400,000	
No. 3		750	860	935	1,200,000	
Stud		775	895	970	1,200,000	

TABLE 3605.2.3.1d - continued
DESIGN VALUES FOR DIMENSION LUMBER - VISUAL GRADING

SPECIES AND GRADE	SIZE	NORMAL DURATION	DESIGN VALUE IN BENDING "*Fb*"		MODULUS OF ELASTICITY "E"	GRADING RULES AGENCY
			Snow Loading	7-Day Loading		
Select Structural	2” x 8”	1,725	1,985	2,155	1,500,000	National Lumber Grades Authority (See Footnotes 1 and 2)
No. 1/ No. 2		1,210	1,390	1,510	1,400,000	
No. 3		690	795	865	1,200,000	
Select Structural	2”x 10”	1,580	1,820	1,975	1,500,000	
No. 1/ No. 2		1,105	1,275	1,385	1,400,000	
No. 3		635	725	790	1,200,000	
Select Structural	2” x 12”	1,440	1,655	1,795	1,500,000	
No. 1/ No. 2		1,005	1,155	1,260	1,400,000	
No. 3		575	660	720	1,200,000	
No 3. open grain		540	620	670	900,000	
SPRUCE - PINE - FIR (SOUTH)						
Select Structural	2” x 4”	2,245	2,580	2,805	1,300,000	Northeastern Lumber Manufacturers Association Northern Softwood Lumber Bureau West Coast Lumber Inspection Bureau Western Woods Products Association (See Footnotes 1 and 2)
No. 1		1,465	1,685	1,835	1,200,000	
No. 2		1,295	1,490	1,615	1,100,000	
No. 3		735	845	915	1,000,000	
Stud		725	835	910	1,000,000	
Construction		980	1,125	1,220	1,000,000	
Standard		545	630	685	900,000	
Utility		260	300	335	900,000	
Select Structural	2”x 6”	1,945	2,235	2,430	1,300,000	
No. 1		1,270	1,460	1,590	1,200,000	
No. 2		1,120	1,290	1,400	1,100,000	
No. 3		635	730	795	1,000,000	
Stud		660	760	825	1,000,000	
Select Structural	2” x 8”	1,795	2,065	2,245	1,300,000	
No. 1		1,175	1,350	1,465	1,200,000	
No. 2		1,035	1,190	1,295	1,100,000	
No. 3		585	675	735	1,000,000	
Select Structural	2”x 10”	1,645	1,890	2,055	1,300,000	
No. 1		1,075	1,235	1,345	1,200,000	
No. 2		950	1,090	1,185	1,100,000	
No. 3		540	620	670	1,000,000	
Select Structural	2” x 12”	1,495	1,720	1,870	1,300,000	
No. 1		980	1,125	1,220	1,200,000	
No. 2		865	990	1,080	1,100,000	
No. 3		490	560	610	1,000,000	
WESTERN CEDARS						
Select Structural	2” x 4”	1,725	1,985	2,155	1,100,000	West Coast Lumber Inspection Bureau Western Woods Products Association (See Footnotes 1 and 2)
No. 1		1,250	1,440	1,565	1,000,000	
No. 2		1,210	1,390	1,510	1,000,000	
No. 3		690	795	865	900,000	
Stud		695	800	870	900,000	
Construction		920	1,060	1,150	900,000	
Standard		520	595	645	800,000	
Utility		260	300	325	800,000	
Select Structural	2”x 6”	1,495	1,720	1,870	1,100,000	
No. 1		1,085	1,245	1,355	1,000,000	

TABLE 3605.2.3.1d - continued
DESIGN VALUES FOR DIMENSION LUMBER - VISUAL GRADING

SPECIES AND GRADE	**SIZE**	**NORMAL DURATION**	**DESIGN VALUE IN BENDING "*Fb*"**		**MODULUS OF ELASTICITY "E"**	**GRADING RULES AGENCY**
			Snow Loading	**7-Day Loading**		
No. 2	2" x 6"	1,045	1,205	1,310	1,000,000	West Coast Lumber Inspection Bureau Western Woods Products Association (See Footnotes 1 and 2)
No. 3		600	690	750	900,000	
Stud		635	725	790	900,000	
Select Structural	2" x 8"	1,380	1,585	1,725	1,100,000	
No. 1		1,000	1,150	1,250	1,000,000	
No. 2		965	1,110	1,210	1,000,000	
No. 3		550	635	690	900,000	
Select Structural	2"x 10"	1,265	1,455	1,580	1,100,000	
No. 1		915	1,055	1,145	1,000,000	
No. 2		885	1,020	1,105	1,000,000	
No. 3		505	580	635	900,000	
Select Structural	2" x 12"	1,150	1,325	1,440	1,100,000	
No. 1		835	960	1,040	1,000,000	
No. 2		805	925	1,005	1,000,000	
No. 3		460	530	575	900,000	
WESTERN WOODS						
Select Structural	2" x 4"	1,150	1,735	1,885	1,200,000	West Coast Lumber Inspection Bureau Western Woods Products Association (See Footnotes 1 and 2)
No. 1		1,120	1,290	1,400	1,100,000	
No. 2		1,120	1,290	1,400	1,000,000	
No. 3		645	745	810	900,000	
Stud		635	725	790	900,000	
Construction		835	960	1,040	1,000,000	
Standard		460	530	575	900,000	
Utility		230	265	290	800,000	
Select Structural	2"x 6"	1,310	1,505	1,635	1,200,000	
No. 1		970	1,120	1,215	1,100,000	
No. 2		970	1,120	1,215	1,000,000	
No. 3		560	645	700	900,000	
Stud		575	660	720	900,000	
Select Structural	2" x 8"	1,210	1,390	1,510	1,200,000	
No. 1		895	1,030	1,120	1,100,000	
No. 2		895	1,030	1,120	1,000,000	
No. 3		520	595	645	900,000	
Select Structural	2"x 10"	1,105	1,275	1,385	1,200,000	
No. 1		820	945	1,030	1,100,000	
No. 2		820	945	1,030	1,000,000	
No. 3		475	545	595	900,000	
Select Structural	2" x 12"	1,005	1,155	1,260	1,200,000	
No. 1		750	860	935	1,100,000	
No. 2		750	860	935	1,000,000	
No. 3		430	495	540	900,000	
WHITE OAK						
Select Structural	2" x 4"	2,070	2,380	2,590	1,100,000	
No. 1		1,510	1,735	1,885	1,000,000	
No. 2		1,465	1,685	1,835	900,000	
No. 3		820	940	1,025	800,000	
Stud		820	945	1,030	800,000	
Construction		1,095	1,255	1,365	900,000	

TABLE 3605.2.3.1d - continued
DESIGN VALUES FOR DIMENSION LUMBER - VISUAL GRADING

SPECIES AND GRADE	SIZE	NORMAL DURATION	DESIGN VALUE IN BENDING "*Fb*"		MODULUS OF ELASTICITY "E"	GRADING RULES AGENCY
			Snow Loading	7-Day Loading		
Standard	2" x 4"	605	695	755	800,000	Northern Lumber Manufacturers Association (See Footnotes 1 and 2)
Utility		290	330	360	800,000	
Select Structural	2"x 6"	1,795	2,065	2,245	1,100,000	
No. 1		1,310	1,505	1,635	1,000,000	
No. 2		1,270	1,460	1,590	900,000	
No. 3		710	815	890	800,000	
Stud		750	860	935	800,000	
Select Structural	2" x 8"	1,655	1,905	2,070	1,100,000	
No. 1		1,210	1,390	1,510	1,000,000	
No. 2		1,175	1,350	1,465	900,000	
No. 3		655	755	820	800,000	
Select Structural	2"x 10"	1,520	1,745	1,900	1,100,000	
No. 1		1,105	1,275	1,385	1,000,000	
No. 2		1,075	1,235	1,345	900,000	
No. 3		600	690	750	800,000	
Select Structural	2" x 12"	1,380	1,585	1,725	1,100,000	
No. 1		1,005	1,155	1,260	1,000,000	
No. 2		980	1,125	1,220	900,000	
No. 3		545	630	685	800,000	
YELLOW POPLAR						
Select Structural	2" x 4"	1,725	1,985	2,155	1,500,000	Northern Softwood Lumber Bureau (See Footnotes 1 and 2)
No. 1		1,250	1,440	1,565	1,400,000	
No. 2		1,210	1,390	1,510	1,300,000	
No. 3		690	795	865	1,200,000	
Stud		695	800	870	1,200,000	
Construction		920	1,060	1,150	1,300,000	
Standard		520	595	645	1,100,000	
Utility		230	265	290	1,100,000	
Select Structural	2"x 6"	1,495	1,720	1,870	1,500,000	
No. 1		1,085	1,245	1,355	1,400,000	
No. 2		1,045	1,205	1,310	1,300,000	
No. 3		600	690	750	1,200,000	
Stud		635	725	790	1,200,000	
Select Structural	2" x 8"	1,380	1,585	1,725	1,500,000	
No. 1		1,000	1,150	1,250	1,400,000	
No. 2		965	1,110	1,210	1,300,000	
No. 3		550	635	690	1,200,000	
Select Structural	2"x 10"	1,265	1,455	1,580	1,500,000	
No. 1		915	1,055	1,145	1,400,000	
No. 2		885	1,020	1,105	1,300,000	
No. 3		505	580	635	1,200,000	
Select Structural	2" x 12"	1,150	1,325	1,440	1,500,000	
No. 1		835	960	1,040	1,400,000	
No. 2		805	925	1,005	1,300,000	
No. 3		460	530	575	1,200,000	

For SI: 1 inch = 25.4 mm, 1 psi = 6.895 kPa.

1. When dimension lumber is used where moisture content will exceed 19% for an extended time period, F_b shall be multiplied by 0.85 if F_b exceeds 1,150 psi, and E shall be multiplied by 0.9.
2. Following is a list of agencies certified by the American Lumber Standards Committee Board of Review (as of 1991) for inspection and grading of untreated lumber under the rules indicated.

Rules in Writing Agencies	**Rules for which grading is authorized**
National Lumber Grades Authority (NLGA) 260-1055 W. Hastings Street Vancouver, BC V6E 2E9 Canada	NLGA
Northeastern Lumber Manufacturers Association (NELMA) 272 Tuttle Road, P.O. Box 87A Cumberland Center, Maine 04021	NELMA, NLGA, WCLIB, WWPA, NLGA
Northern Softwood Lumber Bureau (NSLB) 272 Tuttle Road, P.O. Box 87A Cumberland Center, Maine 04021	WSLB, WCLIB, WWPA, NLGA
Redwood Inspection Service (RIS) 405 Enfrente Drive, Suite 200, Novato, California 94949	RIS,WCLIB, WWPA
Southern Pine Inspection Bureau (SPIB) 4709 Scenic Highway, Pensacola, Florida 32504	SPIB, NELMA, WCLIB, WWPA, NLGA
West Coast Lumber Inspection Bureau (WCLIB) 6980 SW Varnes Road, P.O. Box 23145 Portland, Oregon 97223	WCLIB, RIS, WWPA, NLGA, SPIB
Western Wood Products Association (WWPA) 522 S.W. 5th Avenue Yeon Building, Portland, OR 97204	WWPA, WCLIB, NLGA, RIS, SPIB
Non-Rules Writing Agencies	
California Lumber Inspection Services	RIS, WCLIB, WWPA, NLGA, SPIB
Pacific Lumber Inspection Bureau, Inc.	RIS,WCLIB,WWPA, NLGA
Timber Products Inspection	RIS, SPIB, WCLIS, WWPA
Alberta Forest Products Association	NLGA
Canadian Lumbermen's Association	NLGA, NELMA
Cariboo Lumber Manufacturers Association	NLGA
Central Forest Products Association	NLGA
Council of Forest Industries of British Columbia	NLGA
Interior Lumber Manufacturers Association	NLGA
Macdonald Inspection	NLGAS
Maritime Lumber Bureau	NLGA, NELMA
Ontario Lumber Manufacturers Association	NLGA, NELMA
Pacific Lumber Inspection Bureau	NLGA
Quebec Lumber Manufacturers Association	NLGA, NELMA

TABLE 3605.2.3.1e
DESIGN VALUES FOR DIMENSION LUMBER - MACHINE STRESS RATED

These "F_b" values are for use where repetitive members are spaced not more than 24 inches. For wider spacing, the "F_b" values should be reduced 13%. Values apply at 19% maximum moisture content in use.

GRADE DESIGNATION	GRADING RULES AGENCY (See Footnotes 1,2,3,4)	SIZE CLASSIFICATION	DESIGN VALUE IN BENDING "Fb"			MODULUS OF ELASTICITY "E"
			Normal Duration	Snow Loading	7-Day Loading	
900f.1.0*E*	3,4	Machine rated lumber 2 X 4 and wider	1,050	1,210	1,310	1,000,000
1200f.1.2 *E*	1,2,3,4		1,400	1,610	1,750	1,200,000
1350f.1.3 *E*	2,4		1,550	1,780	1,940	1,300,000
1450f.1.3 *E*	1,3,4		1,650	1,900	2,060	1,300,000
1500f.1.3 *E*	2		1,750	2,010	2,190	1,300,000
1500f.1.4 *E*	1,2,3,4		1,750	2,010	2,190	1,400,000
1650f.1.4 *E*	2		1,900	2,190	2,370	1,400,000
1650f.1.6 *E*	1,2,3,4		1,900	2,180	2,380	1,500,000
1800f.1.6 *E*	1,2,3,4		2,050	2,360	2,560	1,600,000
1950f.1.5 *E*	2		2,250	2,590	2,810	1,500,000
1950f.1.7 *E*	1,2,4		2,250	2,590	2,810	1,700,000
2100f.1.8 *E*	1,2,3,4		2,400	2,760	3,000	1,800,000
2250f.1.6 *E*	2		2,600	2,990	3,250	1,600,000
2250f.1.9 *E*	1,2,4		2,600	2,990	3,250	1,900,000
2400f.1.7 *E*	2		2,750	3,160	3,440	1,700,000
2400f.2.0 *E*	1,2,3,4		2,750	3,160	3,440	2,000,000
2550f.2.1 *E*	1,2,4		2,950	3,390	3,690	2,100,000
2700f.2.2 *E*	1,2,3,4		3,100	3,570	3,880	2,200,000
2850f.2.3 *E*	2		3,300	3,800	4,130	2,300,000
3000f.2.4 *E*	1,2		3,450	3,970	4,310	2,400,000
3150f.2.5 *E*	2		3,600	4,140	4,500	2,500,000
3300f.2.6 *E*	2		3,800	4,370	4,750	2,600,000
900f.1.0 *E*	1,2,3	See Footnotes	1,050	1,210	1,310	1,000,000
900f.1.2 *E*	1,2,3		1,050	1,210	1,310	1,200,000
1200f.1.5 *E*	1,2,3		1,400	1,610	1,750	1,500,000
1350f.1.8 *E*	1,2		1,550	1,780	1,940	1,800,000
1500f.1.8 *E*	3		1,750	2,010	2,190	1,800,000
1800f.2.1 *E*	1,2,3		2,050	2,360	2,560	2,100,000

For **SI:** 1 inch = 25.4 mm, 1 psi = 6.895kPa.

Table 3605.2.3.1d footnotes applicable to machine stress rated joists and rafters.

1. National Lumber Grades Authority (see Footnote 2, Table 3605.2.3.1c); Machine Rated Lumber, 2 X 4 and wider.
2. Southern Pine Inspection Bureau; Machine Rated Lumber, 2 X 4 and wider.
3. West Coast Lumber Inspection Bureau; Machine Rated Lumber, 2 X 4 and wider; Machine Rated Joists, 2 X 6 and wider.
4. Western Wood Products Association; Machine Rated Lumber, 2 X 4 and wider.

TABLE 3605.2.3.3a
ALLOWABLE SPAN FOR GIRDERS SUPPORTING ONE FLOOR ONLY

SIZE OF WOOD GIRDER[2]		FLOOR LIVE LOAD (psf)	SPACING BETWEEN GIRDERS OR BETWEEN GIRDERS AND LOAD BEARING WALLS[3]				
			4 feet	6 feet	8 feet	10 feet	16 feet
4 x 4	-	30	5'6"	4'6"	3'6"	3'0"	2'6"
		40	5'0"	4'0"	3'6"	3'0"	2'6"
4 x 6	-	30	8'0"	6'6"	5'6"	5'0"	4'6"
		40	7'6"	6'0"	5'6"	4'6"	4'0"
4 x 8	6 x 6	30	11'0"	9'0"	8'0"	7'0"	5'6"
		40	10'0"	8'6"	7'6"	6'6"	5'0"
4 x 10	6 x 8	30	14'0"	11'6"	10'0"	8'6"	6'0"
		40	13'0"	10'6"	9'6"	8'6"	5'6"
4 x 12	6 x 10	30	16'6"	14'0"	12'0"	11'0"	9'0"
		40	16'0"	12'6"	11'0"	10'0"	8'0"

For **SI:** 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 pound per square foot = 0.0479 kN/m^2.

1. Allowable spans may be interpolated between tributary loads shown in table. Spans and girder sizes may be computed independently of the above table in accordance with accepted engineering practice.
2. Spans are based on No. 2 lumber.
3. The spacing is the tributary load to the girder. It is found by adding the spans of the floor structure on each side which are supported by the girder and dividing by 2.

TABLE 3605.2.3.3b
ALLOWABLE SPANS FOR BUILT-UP WOOD CENTER GIRDERS AND FOOTING SIZES FOR GIRDER SUPPORT COLUMNS

WIDTH OF STRUCTURE (feet)	GIRDER SIZE (inches)	ONE STORY		TWO STORY		THREE STORY	
		Maximum Span (feet-inches)	Footing Size[3] (inches)	Maximum Span (feet-inches)	Footing Size[3] (inches)	Maximum Span (feet-inches)	Footing Size[3] (inches)
24	3-2x8	6-7	17x17*	4-11	20x20	4-1	22x22
	4-2x8	7-8	19x19*	5-8	21x21	4-9	24x24
	3-2x10	8-5	20x20*	6-3	23x23	5-3	25x25
	4-2x10	9-9	21x21	7-3	24x24	6-1	27x27
	3-2x12	10-3	22x22	7-8	25x25	6-4	27x27
	4-2x12	11-10	23x23	8-10	27x27	7-4	29x29
26	3-2x8	6-4	17x17*	4-9	20x20	3-11	22x22
	4-2x8	7-4	18x18*	5-6	22x22	4-7	24x24
	3-2x10	8-1	19x19	6-1	23x23	5-0	25x25
	4-2x10	9-4	21x21	7-0	24x24	5-10	27x27
	3-2x12	9-10	21x21	7-4	25x25	6-1	28x28
	4-2x12	11-5	23x23	8-6	27x27	7-1	30x30
28	3-2x8	6-2	17x17*	4-7	21x21	3-10	23x23
	4-2x8	7-1	18x18*	5-3	22x22	4-5	24x24
	3-2x10	7-10	19x19	5-10	23x23	4-10	26x26
	4-2x10	9-0	20x20	6-9	25x25	5-7	28x28
	3-2x12	9-6	21x21	7-1	26x26	5-11	28x28
	4-2x12	11-0	22x22	8-2	28x28	6-10	30x30
32	3-2x8	5-9	16x16*	4-3	21x21	3-7	24x24
	4-2x8	6-7	17x17	4-11	23x23	4-1	25x25
	3-2x10	7-4	18x18	5-5	24x24	4-6	27x27
	4-2x10	8-5	20x20	6-3	26x26	5-3	28x28
	3-2x12	8-11	20x20	6-8	27x27	5-6	29x29
	4-2x12	10-3	22x22	7-8	29x29	6-4	31x31

For **SI:** 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 psf = 0.0479 kN/m^2, 1 psi = 6.895 kPa.

1. Values shown are for a clear-span trussed roof, a load bearing center wall on the first floor in a two-story construction, and a load-bearing center wall on the first and second floors in three-story construction.
2. Spans based on allowable stress in bending F_b - 1,000 pounds per square inch (psi) for repetitive members. See Table 3605.2.3.1d
3. Footing size based on 2,000 psf soil-bearing capacity; footing thickness shall be one-half (minimim) the width of the footing, or ten inches, whichever is greater.
4. 4x4 posts may be used at these (*) locations, 6x6 posts, or 4x4 posts or three-inch diameter steel columns with bearing plates or equivalent area, are acceptable in all locations.

3605.2.9 Framing of openings: Openings in floor framing shall be framed with double header and trimmer joists, and shall be of sufficient cross section to support the floor joists framing into the header. Approved hangers shall be used for the header-joist to trimmer joist connections when the header joist span exceeds six feet (1829 mm).

3605.2.10 Floor trusses: Wood floor trusses shall be designed in accordance with approved engineering practice. The design of metal plate connected wood trusses shall comply with TPI QST, TPI PCT and TPI-1 "Design Specification for Metal Plate Connected Wood Trusses, ***as listed in Appendix A***." Trusses shall be braced and installed in accordance with their appropriate engineered design. In the absence of specific bracing requirements, trusses shall be braced in accordance with TPI BWT, ***as listed in Appendix A***. Truss members shall not be drilled, cut, notched or altered in any manner unless so designed.

3605.2.11 Draftstopping required: When there is usable space above and below the concealed space of a floor/ceiling assembly, draftstops shall be installed so that the area of the concealed space does not exceed 1,000 square feet (93 m^2). Draftstopping shall divide the concealed space into approximately equal areas. Draftstopping shall be provided in floor/ceiling assemblies under the following certain circumstances:

1. Ceiling is suspended under the floor framing; or
2. Floor framing is constructed of truss-type open-web or perforated members.
3. The assembly is enclosed by a floor membrane above and a ceiling membrane below.

3605.2.11.1 Materials: Draftstopping materials shall not be less than ½-inch (12.7 mm) gypsum hoard, ⅜-inch (9.5 mm) wood structural panels, ⅜-inch (9.5 mm) Type 2-M-W particleboard or other approved materials adequately supported. Draftstopping shall be installed parallel to the floor framing members unless otherwise approved by the building official. The integrity of all draftstops shall be maintained.

780 CMR 3605.3 FLOOR SHEATHING

3605.3.1 Lumber sheathing: Maximum allowable spans for lumber used as floor sheathing shall conform to Tables ***3605.3.1***, ***3605.3.2.1.1a*** and ***3605.3.2.1.1b***.

3605.3.1.1 End joints. Lumber used as subflooring ***shall be installed with end joints*** over supports unless end-matched lumber is used, in which case each piece shall bear on at least two joists. Subflooring may be omitted when joist spacing does not exceed 16 inches (406 mm) and a one-inch (25 mm) nominal tongue-and-groove wood strip flooring is applied perpendicular to the joists.

TABLE 3605.3.1 MINIMUM THICKNESS OF LUMBER FLOOR SHEATHING

JOIST OR BEAM SPACING (inches)	MINIMUM NET THICKNESS	
	Perpendicular to Joist	Diagonal to Joist
24	11/16	¾
16	⅝	⅝
48[1]	1½ T&G	N/A
54[2]		
60[3]		

For SI: 1 inch = 25.4 mm, 1 psi = 6.895 kPa.

1. Minimum 840 F_b 1,000,000 E.
2. Minimum 950 F_b 1,300,000 E.
3. Minimum 1,060 F_b 1,600,000 E.

3605.3.2 Plywood sheathing:

3605.3.2.1 Identification and grade: Plywood used for structural purposes shall conform to DOC PS 1, DOC PS 2 and HPMA (ANSI) HP, ***as listed in Appendix A***, and wood structural panels shall conform to DOC PS 2, ***as listed in Appendix A***. All panels shall be identified by a grade mark of certificate of inspection issued by an approved agency.

3605.3.2.1.1 Subfloor and combined subfloor underlayment: Where used as subflooring or combination subfloor underlayment, wood structural panels shall be of one of the grades specified in Table ***3605.3.2.1.1a***. When sanded plywood is used as a combination subfloor underlayment, the grade shall be as specified in Table ***3605.3.2.1.1b***.

3605.3.2.1.2 Wood structural panels: Wood structural-use panels conforming to DOC PS 2 includes performance-rated plywood, oriented strand-board and composite panels. Oriented strand-board structural-use panels manufactured in Canada shall conform to CSA 0437, ***as listed in Appendix A***.

3605.3.2.2 Allowable spans: The maximum allowable span for wood structural panels used as subfloor or combination subfloor underlayment shall be as set forth in Table ***3605.3.2.1.1a***. The maximum span for sanded plywood combination subfloor underlayment shall be set forth in Table ***3605.3.2.1.1b***.

3605.3.2.3 Installation: Plywood and wood structural panels used as subfloor or combination subfloor underlayment shall be attached to framing in accordance with Table *3606.2.3a*.

3605.3.3 Particleboard:

3605.3.3.1 Identification and grade: Particleboard shall conform to ANSI A208.1, ***as listed in Appendix A***, and shall be so identified by a grade mark or certificate of inspection issued by an approved agency.

3605.3.3.2 Floor underlayment: Particleboard floor underlayment shall conform to Type PBU, ***as listed in Appendix A***, and shall not be less than ¼-inch (6.4 mm) in thickness.

3605.3.3.3 Installation: Particleboard underlayment shall be installed in accordance with the recommendations of the manufacturer and attached to framing in accordance with Table *3606.2.3a*.

TABLE 3605.3.2.1.1a
ALLOWABLE SPANS AND LOADS FOR PLYWOOD AND WOOD STRUCTURAL PANELS FOR ROOF AND SUBFLOOR SHEATHING AND COMBINATION SUBFLOOR UNDERLAYMENTS[1,2,3]

SPAN RATING	NOMINAL PANEL THICKNESS (inch)	MAXIMUM SPAN (inches)[4]		LOAD (pounds per square foot, at maximum span)		MAXIMUM SPAN (inches)
		With Edge Support	Without Edge Support	Total Load	Live Load	
C-D, C-C, SHEATHING[5]		ROOF[6]				SUBFLOOR[6]
12/0	5/16	12	12	40	30	0
16/0	5/16, ⅜	16	16	40	30	0
20/0	5/16, ⅜	20	20	40	30	0
24/0	⅜, 7/16, ½	24	20[7]	40	30	0
24/16	7/16, ½	24	24	50	40	16
32/16	15/32, ½, ⅝	32	28	40	30	16[8]
40/20	19/32, ⅝, ¾, ⅞	40	32	40	30	20[8,9]
48/24	23/32, ¾, ⅞	48	36	45	35	24
UNDERLAYMENT, C-C PLUGGED SINGLE FLOOR[10]		ROOF[6]				COMBINATION SUBFLOOR UNDERLAYMENT[11]
16 o.c.	19/32, ⅝	24	24	50	40	16[8]
20 o.c.	19/32, ⅝, ¾	32	32	40	30	20[8,9]
24 o.c.	23/32, ¾	48	36	35	25	24
32 o.c.	⅞, 1	48	40	50	40	32
48 o.c.	1 3/32, 1⅛	60	48	50	40	48

For SI: 1 inch = 25.4 mm, 1 psf = 0.0479kNm^{2}

1. The allowable loads were determined using a dead load of 10 psf. If the dead load exceeds 10 psf, then the live load shall be reduced accordingly.
2. Panels continuous over two or more spans with long dimension perpendicular to supports. Spans shall be limited to values shown because of possible effect of concentrated loads.
3. Applies to panels 24 inches or wider.
4. Lumber blocking, panel edge clips (one midway between each support, except two equally spaced between supports when span is 48 inches), tongue-and-groove panel edges, or other approved type of edge support.
5. Includes Structural 1 panels in these grades.
6. Uniform load deflection limitation; 1/180 of span under live load plus dead load, 1/240 of span under live load only.
7. Maximum span 24 inches for ½-inch panels.
8. Maximum span 24 inches where ¾-inch wood finish flooring is installed at right angles to joists.
9. Maximum span 24 inches where 1½ inches of lightweight concrete or approved cellular concrete is placed over the subfloor.
10. Unsupported edges shall have tongue-and-groove joints or shall be supported with blocking unless nominal ¼-inch thick underlayment or 1½ inches of light-weight concrete or approved cellular concrete is placed over the subfloor, or ¾-inch wood finish is used. Allowable uniform live load at maximum span, based on deflection of 1/360 of span, is 100 psf.
11. Unsupported edges shall have tongue-and-groove joints or shall be supported with blocking unless nominal ¼-inch thick underlayment or ¾-inch wood finish flooring is used. Allowable uniform live load at maximum span, based on deflection of 1/360 of span, is 100 psf, except panels with a Span Rating of 48 o.c. are limited to 65 psf total uniform load at maximum span.

TABLE 3605.3.2.1.1b ALLOWABLE SPANS FOR PLYWOOD COMBINATION SUBFLOOR UNDERLAYMENT[1]

IDENTIFICATION	SPACING OF JOISTS		
	16	20	24
Species Group[2]			
1	½	⅝	¾
2,3	⅝	¾	⅞
4	¾	⅞	1

For SI: 1 inch = 25.4 mm, 1psf = 0.0479 kNm^2

1. Plywood continuous over two or more spans and face grain perpendicular to supports. Unsupported edges shall be tongue-and-groove or blocked except where nominal ¼-inch-thick underlayment or ¾-inch wood finish floor is used. Allowable uniform live load at maximum span based on deflection of $^1/_{360}$ of span is 100 psf.
2. Applicable to all grades of sanded Exterior-type plywood.

780 CMR 3605.4 TREATED-WOOD FLOORS (ON GROUND)

3605.4.1 General: Treated-wood basement floors and floors on ground shall be designed to withstand axial forces and bending moments resulting from lateral soil pressures at the base of the exterior walls and floor live and dead loads. Floor framing shall be designed to meet joist deflection requirements in accordance with ***780 CMR 3603.1***.

3605.4.1.1 Unbalanced soil loads: Unless special provision is made to resist sliding caused by unbalanced lateral soil loads, wood basement floors shall be limited to applications where the differential depth of fill on opposite exterior foundation walls is two feet (610 mm) or less.

3605.4.1.2 Construction: Joists in wood basement floors shall bear tightly against the narrow face of studs in the foundation wall or directly against a band joist which bears on the studs. Plywood subfloor shall be continuous over lapped joists or over butt joints between in-line joists. Sufficient blocking shall be provided between joists to transfer lateral forces at the base of the end walls into the floor system.

3605.4.1.3 Uplift and buckling: Where required, resistance to uplift or restraint against buckling shall be provided by interior bearing walls or properly designed stub walls anchored in the supporting soil below.

3605.4.2 Site preparation: The area within the foundation walls shall have all vegetation, topsoil and foreign material removed, and any fill material which is added shall be free of vegetation and foreign material. The fill shall be compacted to assure uniform support of the treated-wood floor sleepers.

3605.4.2.1 Base: A minimum four-inch-thick (102 mm) granular base of gravel having a maximum size of ¾ inch (19 mm) or crushed stone having a maximum size of ½ inch (12.7 mm) shall be placed over the compacted subgrade.

3605.4.2.2 Moisture barrier: Polyethylene sheeting of minimum six-mil (0.15 mm) thickness shall be placed over the granular base. Joints shall be lapped six inches (153 mm) and left unsealed. The polyethylene membrane shall be placed over the treated-wood sleepers and shall not extend beneath the footing plates of the exterior walls.

3605.4.3 Materials: All framing materials, including sleepers, joists, blocking and plywood subflooring, shall be pressure preservatively treated and dried after treatment in accordance with AWPA C22***, as listed in Appendix A***.

780 CMR 3605.5 CONCRETE FLOORS (ON GRADE)

3605.5.1 General: Concrete slab-on-grade floors shall be constructed in accordance with Figure ***3604.3.1a***. The specified compressive strength of concrete at 28 days shall not be less than 2,500 pounds per square inch (17,225 kPa), except where weather exposure requires greater strength and air-entrained concrete, as set forth in Table ***3604.2.2 and 780 CMR 3604.2.2***.

Slabs shall be constructed with control joints having a depth of at least ¼ the slab thickness but not less than one inch, and joints shall be spaced at intervals not more than 30 feet in each direction and slabs not rectangular in shape shall have control joints across the slab at points of offset, if offset exceeds ten feet.

Exception: Control joints are not required or may exceed 30 foot intervals where welded wire fabric or equivalent is provided in accordance with Table 3605.5.1. The welded wire fabric or equivalent material shall be placed at mid-depth of the slab or two inches from the top surface for slabs more than four inches in thickness.

Table 3605.5.1 CRACK CONTROL REINFORCEMENT FOR SLABS

MAXIMUM DIMENSION OF SLAB OR DISTANCE BETWEEN CONTROL JOINTS (Feet)[1]						WWF[2] WIRE SPACING (inches)	WWF[2] WIRE SIZE DESIGNATION
SLAB THICKNESS (inches)							
3.5	4.0	4.5	5.0	5.5	6.0		
42	36	32	29	26	24	6x6	W1.4xW1.4
59	52	46	42	38	35	6x6	W2.0xW2.0
86	75	67	60	55	50	6x6	W2.9xW2.9

1. Values in table are based on reinforcement with a yield strength of 65,000 psi. If reinforcement with a different yield strength is used, the slab dimension shown

in the table shall be adjusted by multiplying by the yield strength of the steel to be used and dividing by 65,000.
2. Welded wire fabric.

3605.5.2 Site preparation: The area within the foundation walls shall ***be cleaned of all*** vegetation ***and organic and foreign material and*** top soil.

3605.5.2.1 Fill: Fill material shall be free of vegetation and foreign material. The fill shall be compacted to assure uniform support of the slab, and except where approved, the fill depths shall not exceed 24 inches (610 mm) for clean sand or gravel.

3605.5.2.2 Base: A four-inch-thick (102 mm) base course consisting of clean graded sand, gravel, crushed stone or crushed blast-furnace slag passing a two-inch (51 mm) sieve shall be placed on the prepared subgrade when the slab is below grade.

Exceptions: A base course is not required when the concrete slab is installed on well-drained or sand-gravel mixture soils according to the United Soil Classification System, Group I Soils.

3605.5.2.3 Vapor barrier: An approved vapor barrier with joints lapped not less than six inches (153 mm) shall be placed between the concrete floor slab and the base course or the prepared subgrade where no base course exists.

Exception: The vapor barrier may be omitted:

1. From detached garages, utility buildings and other unheated accessory structures;
2. From driveways, walks, patios and other flatwork not likely to be enclosed and heated at a later date; or
3. Where approved by the building official, based on local site conditions.

780 CMR 3605.6 METAL

3605.6.1 General: ***Steel and aluminum elements shall be constructed of materials and designed in accordance with the AISC "Specification for the Design, Fabrication and Erection of Structural Steel Buildings" and AA SAS30, respectively, as listed in Appendix A. Steel elements may be hot-rolled or cold-formed structural steel.*** Members shall be straight and free of any defects which would significantly affect their structural performance.

WALL CONSTRUCTION

780 CMR 3606.1 GENERAL

3606.1.1 Application: The provisions of 780 CMR 3606.1 shall control the design and construction of all walls and partitions for all buildings. The use of materials or methods of construction not specified in this chapter accomplishing the purposes intended by 780 CMR 36 and approved by the building official in accordance with ***780 CMR 109.0*** shall be accepted as complying with 780 CMR 36.

3606.1.2 Requirements: The wall construction shall be capable of accommodating all loads imposed according to ***780 CMR 3603.1*** and transmitting the resulting loads to supporting structural elements.

> **3606.1.2.1 Floor-covering materials**: ***Interior and exterior bearing and non-loadbearing walls shall be placed directly on floor sheathing, underlayment or a structural framing member, fastened in accordance with Table 3606.2.3a.*** Compressible floor-covering materials that compress more than $^1/_{32}$ inch (0.794 mm) when subjected to 50 pounds (23 kg) applied over one square inch (645 mm) of material and are greater than ⅛ inch (3.2 mm) in thickness in the uncompressed state shall not extend beneath walls, partitions or columns which are fastened to the floor.

780 CMR 3606.2 WALL FRAMING

3606.2.1 Identification: Load-bearing dimension lumber used for studs, plates and headers shall conform to DOC PS 20, ***as listed in Appendix A***, and to other applicable standards and grading rules and shall be identified by a grade mark, or certificate of inspection issued by an approved agency. The grade mark or certificate shall provide adequate information to determine the "F_b" the allowable stress in bending, and "E," the modulus of elasticity. Approved end-jointed lumber may be used interchangeably with solid-sawn members of the same species and grade.

> ***Exception: Native Lumber as identified in 780 CMR 2303.2 and 780 CMR R4.***

3606.2.2 Grade: Studs shall be a minimum No. 3, Standard or Stud grade lumber.

> **Exception**: Bearing studs not supporting floors and nonbearing studs may be Utility grade lumber, provided the studs are spaced in accordance with Table 3606.2.3d.

3606.2.3 Exterior Walls: Exterior walls of wood-frame construction shall be designed and constructed in accordance with the provisions of 780 CMR 3606.2 and ***Figures 3606.2.3a*** and ***3606.2.3b***. Components of exterior walls shall be fastened in accordance with ***Tables 3606.2.3a*** through ***3606.2.3d***.

> **3606.2.3.1 Special provisions for high wind loads**: Exterior walls subject to wind pressures of 30 pounds per square foot (1.44 kN/m^2) or greater, as established ***by wind load maps, 780 CMR 1611.1a, b and c,*** shall be designed in accordance with accepted engineering practice.
>
> **3606.2.3.2 Stud spacing**: In bearing walls, studs which are not more than ten feet (3048 mm) in length shall be spaced not more than is specified in ***Table 3606.2.3d*** for the corresponding stud size.
>
> **3606.2.3.3 Top plate**: Exterior wall studs shall be capped with a double top plate installed to provide overlapping at corners and intersections with bearing partitions. End joints in top plates shall be offset at least 48 inches (1219 mm).
>
> > **Exception**: A single top plate may be installed in bearing and exterior walls, provided the plate is adequately tied at joints, corners and intersecting walls with three-inch-by-six-inch by a 0.036-inch-thick (76 mm by 153 mm by 0.914 mm) galvanized steel plate that is nailed to each wall or segment of wall by three 8d nails, provided the rafters or joists are centered over the studs with a tolerance of no more than one inch (25 mm). The top plate may be omitted over lintels which are adequately tied to adjacent wall sections with steel plates or equivalent as previously described.
>
> **3606.2.3.4 Bearing studs**: Where floor or roof framing members are spaced more than 16 inches (406 mm) on center and the bearing studs are spaced 24 inches (610 mm) on center, such members shall bear within five inches (127 mm) of the ***bearing studs***.
>
> > **Exceptions**:
> >
> > 1. The top plates are two two-inch-by-six-inch (51 mm by 153 mm) or two three-inch-by-four-inch (76 mm by 102 mm) members.
> > 2. A third top plate is installed.
> > 3. Solid blocking equal in size to the studs is installed to reinforce the double top plate.

3606.2.4 Interior load-bearing partitions: Interior load-bearing partitions shall be constructed, framed and firestopped as specified for exterior walls.

3606.2.4.1 Interior nonbearing partitions: Interior nonbearing partitions may be constructed with two-inch-by-three-inch (51 mm by 76 mm) studs spaced 24 inches (610 mm) on center or two-inch-by-four-inch (51 mm by 102 mm) flat studs spaced 16 inches (406 mm) on center. Interior nonbearing partitions may be capped with a single top plate.

3606.2.5 Drilling and notching-studs: Any stud in an exterior wall or bearing partition may be cut or notched to a depth not exceeding 25% of its width. Studs in nonbearing partitions may be notched to a depth not to exceed 40% of a single stud width. Any stud may be bored or drilled, provided that the diameter of the resulting hole is no greater than 40% of the stud width, the edge of the hole is no closer than ⅝ inch (15.9 mm) to the edge of the stud, and the hole is not located in the same section as a cut or notch.

Exception: A stud may be bored to a diameter not exceeding 60% of its width, provided that such studs when located in exterior walls or bearing partitions are doubled and that not more than two successive studs are bored.

TABLE 3606.2.3a
FASTENER SCHEDULE FOR STRUCTURAL MEMBERS

DESCRIPTION OF BUILDING ELEMENTS	NUMBER AND TYPE OF FASTENERS[1,2,3,4]	SPACING OF FASTENERS
Joist to sill or girder, toe nail	3-8d	-
1" x 6" subfloor or less to each joist, face nail	2-8d	-
	2 staples, 1¾"	-
2" subfloor to joist to girder, blind and face nail	2-16d	-
Sole plate to joist or blocking, face nail	16d	16d" o.c.
Top or sole plate to stud, end nail	2-16d	-
Stud to sole plate, toe nail	3-8d or 2-16d	-
Double studs, face nail	10d	24" o.c.
Double top plates, face nail	10d	24" o.c.
Double top plates, minimum 48-inch offset of end to joints, face nail in lapped area	4-10d	-
Top plates, laps at corners and intersections, face nail	2-10d	-
Built-up header, two pieces with ½" spacer	16d	16" o.c. along each edge
Continued header, two pieces	16d	16" o.c. along each edge
Ceiling joists to plate, toe plate	3-8d	-
Continuous header to stud, toe nail	4-8d	-
Ceiling joist, laps over partitions, face nail	3-10d	-
Ceiling joist to parallel rafters, face nail	3-10d	-
Rafter to plate, toe nail	2-16d	-
1" brace to each stud and plate, face nail	2-8d	-
	2 staples, 1¾"	-
1" x 6" sheathing to each bearing, face nail	2-8d	-
	2 staples, 1¾"	-
1" x 8" sheathing to each bearing, face nail	3-8d	-
	3 staples, 1¾"	-
Wider than 1" x 8" sheathing to each bearing, face nail	3-8d	-
	4 staples, 1¾"	-
Built up corner studs	10d	24" o.c.
Built-up girders and beams, 2-inch lumber layers	10d	Nail each layer as follows: 32: o.c. at top and bottom and staggered. Two nails at ends and at each splice.
2" planks	2-16d	At each bearing
Roof Rafters to ridge, valley or hip rafters:	4-16d	-
toe nail	3-16d	-
face nail		
Rafter ties to rafters, face	3/8d	-

DESCRIPTION OF BUILDING MATERIALS	DESCRIPTION OF FASTENER[2,3,4,5]	SPACING OF FASTENERS	
		Edges (inches)	Intermediate Supports[3,5] (inches)
Plywood and wood structural panels, subfloor, roof and wall sheathing to framing, and particleboard wall sheathing to framing			
⁵⁄₁₆" - ½"	6d common nail (subfloor, wall) 8d common nail (roof)[6]	6	12[7]
¹⁹⁄₃₂" - 1"	8d common nail	6	12[7]
1⅛" - 1¼	10d common nail or 8d deformed nail	6	12

DESCRIPTION OF BUILDING MATERIALS	DESCRIPTION OF FASTENER[2,3,4,5]	SPACING OF FASTENERS	
		Edges (inches)	Intermediate Supports[3,5] (inches)
Other wall sheathing[8]			
½″ gypsum sheathing	1½″ galvanized roofing nail; 6d common nail; staple galvanized, 1½″ long; 1¼″ screws, Type W or S	4	8
⅝″ gypsum sheathing	1¾″ galvanized roofing nail; 8d common nail; Staple galvanized, 1⅝″ long, 1⅝″ screws, Type W or S	4	8
Plywood and wood structural panels, conbination subfloor underlayment to framing			
¾″ and less	6d deformed nail, or 8d common nail	6	12
⅞″ - 1″	8d common nail or 8d deformed nail	6	12
1⅛″ - 1¼″	10d common nail or 8d deformed nail	6	12

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 mph = 1.609 km/h.

1. All nails are smooth-common, box or deformed shanks except where otherwise stated.
2. Staples are 16 gauge wire and have a minimum 7/16-inch O.D. crown width.
3. Nails shall be spaced not more than six inches o.c. at all supports where spans are 48 inches or greater.
4. Four-foot by eight-foot or four-foot-by-nine-foot panels shall be applied vertically.
5. Spacing of fasteners not included in this table shall be based on Table 3606.2.3a(1).
6. For regions having basic wind speed of 90 mph or greater, 8d deformed nails shall be used for attaching plywood and wood structural panel roof sheathing to framing within minimum 48-inch distance from gable end walls, if mean roof height is more than 24 feet, up to 35 feet maximum.
7. For regions having basic wind speed of 80 mph or less, nails for attaching plywood and wood structural panel roof sheathing to gable end wall framing shall be spaced six inches o.c. When basic wind speed is greater than 80 mph, nails for attaching panel roof sheathing to intermediate supports shall be spaced six inches o.c. for minimum 48-inch distance from ridges, eaves and gable end walls; and four inches o.c. to gable end wall framing.
8. Gypsum sheathing shall conform to ASTM C 79 and shall be installed in accordance with GA 253. Fiberboard sheathing shall conform to either AHA 194.1 or ASTM C 208.

TABLE 3606.2.3a(1)
ALTERNATE ATTACHMENTS

NOMINAL MATERIAL THICKNESS	DESCRIPTION[1,2] OF FASTENER AND LENGTH	SPACING[3] OF FASTENERS	
		Edges (inches)	Intermediate Supports (inches)
Plywood and wood structural panels subfloor, roof and wall sheathing to framing and particleboard wall sheathing to framing			
5/16″	0.097 -0.099 Nail 1½″ Staple 15 ga 1⅜″	6	12
⅜″	Staple 15 ga 1⅜″	6	12
	0.097 -0.099 Nail 1½″	4	10
15/32″ and ½″	Staple 15 ga 1½″	6	12
	0.097 -0.099 Nail 1⅝″	3	6
19/32″ and ⅝″	0.113 Nail 1⅞″ Staple 15 and 16 ga. 1⅝″	6	12
	0.097 -0.099 Nail 1¾″	3	6
23/32″ and ¾″	Staple 14 ga. 1¾″	6	12
	Staple 15 ga. 1¾″	5	10
	0.097 -0.099 Nail 1⅞″	3	6
1″	Staple 14 ga. 2″	5	10
	0.113 Nail 2¼″ Staple 15 ga. 2″	4	8
	0.097 -0.099 Nail 2⅛″	3	6
Floor underlayment; plywood-hardboard-particleboard		Edges (inches)	Body of Panel[4]
Plywood			
¼″ and 5/16″	1¼″ ring or screw shank nail - minimum 12½ ga. (0.099″) shank diameter	6	8
11/32″, and ⅜,″ 15/32″ and ½″	1¼″ ring or screw shank nail - minimum 12½ ga. (0.099″) shank diameter	6	8[5]
19/32″, and ⅝″, 23/32″ and ¾″	1½″ ring or screw shank nail - minimum 12½ ga. (0.099″) shank diameter	6	12

NOMINAL MATERIAL THICKNESS	DESCRIPTION[1,2] OF FASTENER AND LENGTH	SPACING[3] OF FASTENERS	
		Edges (inches)	Body of Panel[4]
Hardboard 0.200"	1½" long ring-grooved underlayment nail	6	6
	4d cement-coated sinker nail	6	6
	Staple 18 ga. ⅞" long (plastic coated)	3	6
Particleboard ¼"	4d ring-grooved underlayment nail	3	6
	Staple 18 ga. ⅞" long $^{3}/_{16}$" crown	3	6
⅜"	6d ring-grooved underlayment nail	6	10
	Staple 16 ga. 1⅛" long ⅜" crown	3	6
½" - ⅝"	6d ring-grooved underlayment nail	6	10
	Staple 16 ga. 1⅝" long ⅜" crown	3	6

For SI: 1 inch = 25.4 mm.

1. Nail is a general description and may be T-head, modified round head, or round head.
2. Staples shall have a minimum crown width of $^{7}/_{16}$-inch o.d. except as noted.
3. Nails or staples shall be spaced at not more than six inches o.c. at all supports where spans are 48 inches or greater. Nails or staples shall be spaced at not more than ten inches o.c. at intermediate supports for floors.
4. Fasteners shall be placed in a grid pattern throughout the body of the panel.
5. For 5-ply panels, intermediate nails shall be spaced not more than 12 inches o.c. each way.

TABLE 3606.2.3b
ALLOWABLE STUD SPACING FOR WOOD STRUCTURAL PANEL WALL SHEATHING

PANEL SPAN RATING	PANEL NOMINAL THICKNESS (inch)	MAXIMUM STUD SPACING (inches)	
		Siding Nailed to:[1]	
		Stud	Sheathing
12/0 16/0, 20/0, or Wall - 16 o.c.	$^{5}/_{16}$, ⅜	16	16[2]
24/0, 24/16, 32/16 or Wall - 24 o.c.	⅜, $^{7}/_{16}$, $^{15}/_{32}$, ½	24	24[3]

For SI: 1 inch = 25.4 mm.

1 Blocking of horizontal joints shall not be required.

2. Plywood sheathing ⅜-inch thick or less shall be applied with long dimension across studs.

3. Three-ply plywood panels shall be applied with long dimension across studs.

TABLE 3606.2.3c
ALLOWABLE SPANS FOR PARTICLEBOARD WALL SHEATHING[1]

THICKNESS (inches)	GRADE	STUD SPACING (inches)	
		When Siding is nailed to Studs	When Siding is Nailed to Sheathing
⅜	M-1 Exterior Glue	16	-
½	M-2 Exterior Glue	16	16

For SI: 1 inch = 25.4 mm.

1. Wall sheathing not exposed to the weather. If the panels are applied horizontally, the end joints of the panels shall be offset so that four panels corners will not meet. All panel edges must be supported. Leave a $^{1}/_{16}$-inch gap between panels and nail to no closer than ⅜ inch from panel edges.

TABLE 3606.2.3d
MAXIMUM STUD SPACING (inches)

STUD SIZE	SUPPORTING ROOF AND CEILING ONLY	SUPPORTING ONE FLOOR ROOF AND CEILING	SUPPORTING TWO FLOORS ROOF AND CEILING	SUPPORTING ONE FLOOR ONLY
2 x 4	24[1]	16	-	24[1]
3 x 4	24[1]	24	16	24
2 x 5	24	24	-	24
2 x 6	24	24	16	24

For SI: 1 inch = 25.4 mm.

1 Shall be reduced to 16 inches if Utility grade studs are used.

3606.2.5.1 Drilling and notching-top plate: When piping or ductwork is placed in or partly in an exterior wall or interior load-bearing wall, necessitating a cutting of the top plate by more than 50% of its width, the plate shall be reinforced *to provide equivalent strength.*

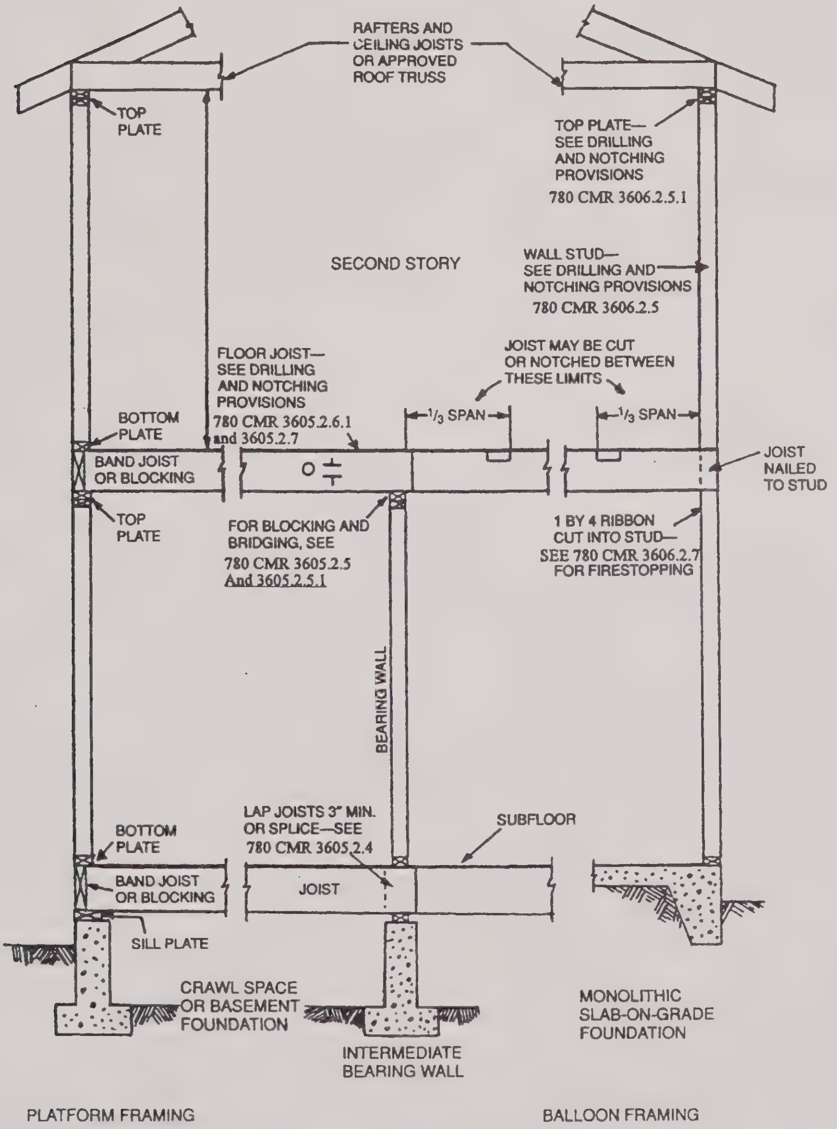
3606.2.6 Headers: The allowable spans for nominal four-inch thick (102 mm) single headers and two-inch thick (51 mm) double headers in bearing walls shall not exceed the spans set forth in Table *3606.2.6*. The table shall not be used where concentrated loads are supported by the headers.

3606.2.6.1 Single headers: Nominal two-inch thick (51 mm) single headers ***shall not be used in*** load-bearing walls.

3606.2.6.2 Plywood box headers: Plywood box headers shall be constructed in accordance with Figure ***3606.2.6.2*** and Table ***3606.2.6.2***.

3606.2.6.3 Non-bearing walls: Load-bearing headers are not required in interior or exterior nonbearing walls. A single flat two-inch-by-four-inch (51 mm by 102 mm) member may be used as a header in interior or exterior nonbearing walls for openings up to eight feet (2438 mm) in width if the vertical distance to the parallel nailing surface above is not more than 24 inches (610 mm). *Cripple spacing shall be the same as spacing of studs.*

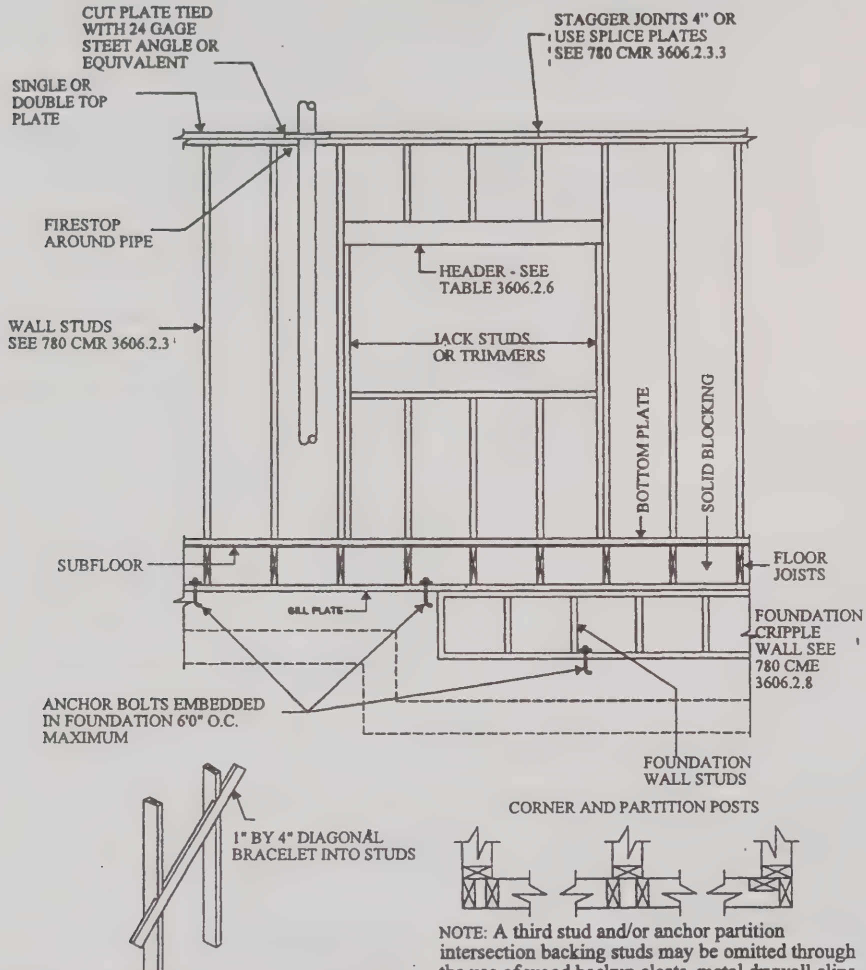
FIGURE 3606.2.3a
TYPICAL WALL, FLOOR AND ROOF FRAMING


RAFTERS AND CEILING JOISTS OR APPROVED ROOF TRUSS
TOP PLATE
TOP PLATE—SEE DRILLING AND NOTCHING PROVISIONS 780 CMR 3606.2.5.1
SECOND STORY
WALL STUD—SEE DRILLING AND NOTCHING PROVISIONS 780 CMR 3606.2.5
FLOOR JOIST—SEE DRILLING AND NOTCHING PROVISIONS 780 CMR 3605.2.6.1 and 3605.2.7
JOIST MAY BE CUT OR NOTCHED BETWEEN THESE LIMITS
1/3 SPAN
1/3 SPAN
BOTTOM PLATE
BAND JOIST OR BLOCKING
JOIST NAILED TO STUD
TOP PLATE
FOR BLOCKING AND BRIDGING, SEE 780 CMR 3605.2.5 And 3605.2.5.1
1 BY 4 RIBBON CUT INTO STUD—SEE 780 CMR 3606.2.7 FOR FIRESTOPPING
BEARING WALL
BOTTOM PLATE
LAP JOISTS 3" MIN. OR SPLICE—SEE 780 CMR 3605.2.4
SUBFLOOR
BAND JOIST OR BLOCKING
JOIST
SILL PLATE
CRAWL SPACE OR BASEMENT FOUNDATION
INTERMEDIATE BEARING WALL
MONOLITHIC SLAB-ON-GRADE FOUNDATION
PLATFORM FRAMING
BALLOON FRAMING

NOTE: See Figure 3604.3.1a for other foundation types

For SI: 1 inch = 25.4 mm.

FIGURE 3606.2.3b
FRAMING DETAILS


CUT PLATE TIED WITH 24 GAGE STEET ANGLE OR EQUIVALENT
STAGGER JOINTS 4" OR USE SPLICE PLATES SEE 780 CMR 3606.2.3.3
SINGLE OR DOUBLE TOP PLATE
FIRESTOP AROUND PIPE
HEADER - SEE TABLE 3606.2.6
WALL STUDS SEE 780 CMR 3606.2.3
JACK STUDS OR TRIMMERS
BOTTOM PLATE
SOLID BLOCKING
SUBFLOOR
FLOOR JOISTS
SILL PLATE
FOUNDATION CRIPPLE WALL SEE 780 CME 3606.2.8
ANCHOR BOLTS EMBEDDED IN FOUNDATION 6'0" O.C. MAXIMUM
FOUNDATION WALL STUDS
1" BY 4" DIAGONAL BRACELET INTO STUDS
CORNER AND PARTITION POSTS

Apply approved sheathing or brace exterior walls with 1" by 4" braces let into studs and plates and extending from bottom plate to top plate.
See 780 CMR 3606.2.9.

NOTE: A third stud and/or anchor partition intersection backing studs may be omitted through the use of wood backup cleats, metal drywall clips or other approved devices that will serve as an adequate backing for the facing materials

For SI: 1 inch = 25.4 mm, 1 foot = 204.8 mm.

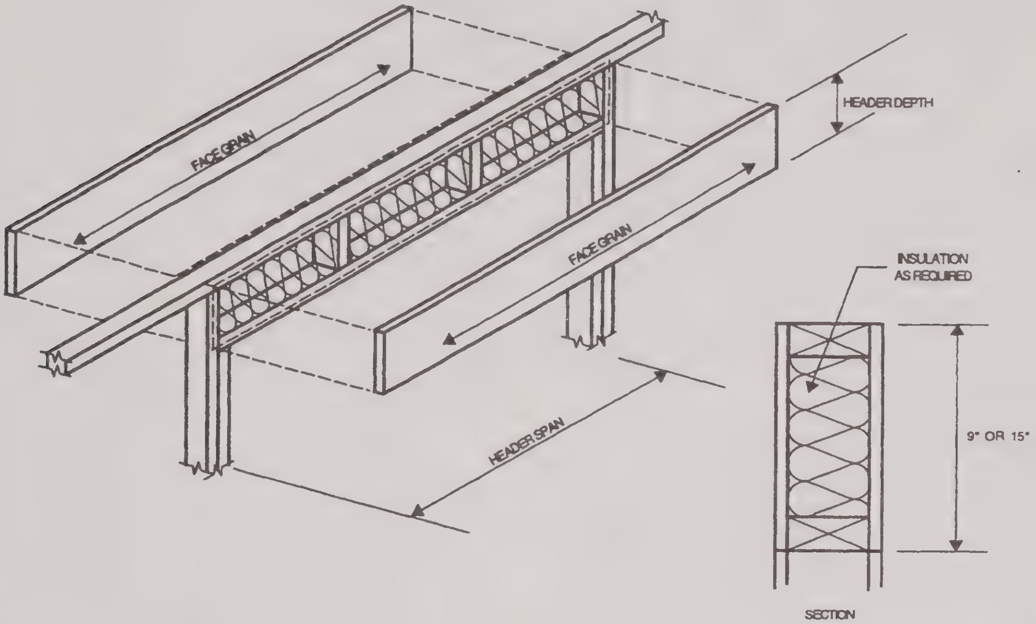
TABLE 3606.2.6
MAXIMUM SPANS FOR HEADERS LOCATED OVER OPENINGS IN WALLS

SIZE OF HEADER[1,2]	HEADERS IN BEARING WALLS[2]			HEADERS IN WALLS NOT SUPPORTING FLOORS OR ROOFS
	Supporting Roof Only	One Story Above	Two Stories Above	
2 - 2 x 4	4	-	-	-
2 - 2 x 6	6	4	-	-
2 - 2 x 8	8	6	-	10
2 - 2 x 10	10	8	6	12
2 - 2 x 12	12	10	8	16

For SI: 1 inch = 25.4 mm, 1 foot 304.8 mm.

1. Nominal four-inch thick single headers may be substituted for double members.
2. Spans are based on No. 2 Grade Lumber with ten-foot tributary floor and roof loads.

FIGURE 3606.2.6.2
TYPICAL PLYWOOD BOX HEADER CONSTRUCTION



For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm.

1 The top plate shall be continuous over header.

2. Jack studs shall be used for spans over four feet.

3. Cripple spacing shall be the same as for studs.

4. Plywood faces shall be single pieces of $^{15}/_{32}$-inch-thick C-D (exterior glue) or better, installed on the interior or exterior or both sides of the header.

5. Plywood faces shall be nailed to framing and cripples with 8d common nails spaced three inches o.c. staggering alternate nails ½ inch.

TABLE 3606.2.6.2
MAXIMUM SPANS FOR PLYWOOD BOX HEADERS (feet)[1]

HEADER CONSTRUCTION[2]	HEADER DEPTH (inches)	HOUSE DEPTH (feet)				
		24	26	28	30	32
Plywood One Side	9	4	4	3	3	-
	15	5	5	4	3	3
Plywood Both Sides	9	7	5	5	4	3
	15	8	8	7	7	6

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm.

1. Spans are based on single story with clear-span trussed roof or two story with floor and roof supported by interior-bearing walls.

2. See Figure 3606.2.6.2 for construction details.

3606.2.7 Firestopping: Firestopping shall be provided to cut off all concealed draft openings (both vertical and horizontal) and to form an effective fire barrier between stories, and between a top story and the roof space. Firestopping shall be provided in wood-frame construction in the following locations.

1. In concealed spaces of stud walls and partitions, including furred spaces, at the ceiling and floor level;
2. At all interconnections between concealed vertical and horizontal spaces such as occur at soffits, drop ceilings, cove ceilings, etc.;
3. In concealed spaces between stair stringers at the top and bottom of the run;
4. At openings around vents, pipes, ducts, chimneys and fireplaces at ceiling and floor level, with noncombustible materials.

3606.2.7.1 Materials: Except as provided in 780 CMR 3606.2.7 item 4, fire-stopping shall consist of two-inch (51 mm) nominal lumber, or two thicknesses of one-inch (25 mm) nominal lumber with broken lap joints, or one thickness of $^{23}/_{32}$-inch (18 mm) wood structural panels with joints backed by $^{23}/_{32}$-inch (18 mm) wood structural panels or one thickness of ¾-inch (19 mm) particleboard with joints backed by ¾-inch (19 mm) particleboard, ½-inch (12.7 mm) gypsum board, or ¼-inch (6.4 mm) cement-based mill-board

3606.2.7.1.1 Unfaced fiberglass: Unfaced fiberglass bat insulation used as firestopping shall fill the entire cross section of the wall cavity to a minimum height of 16 inches (406 mm) measured vertically. When piping, conduit or similar obstructions are encountered, the insulation shall be packed tightly around the obstruction.

3606.2.7.1.2 Firestopping integrity: The integrity of all firestops shall be maintained.

3606.2.8 Cripple walls: Foundation cripple walls shall be framed of studs not less in size than the studs supported. When exceeding four feet (1219 mm) in height, such walls shall be framed of studs having the size required for an additional story.

3606.2.8.1 Bracing: Such walls having a stud height exceeding 14 inches (356 mm) shall be considered to be first story walls for the purpose of determining the bracing required by 780 CMR 3606.2.9. Stud walls less than 14 inches (356 mm) in height shall be sheathed with plywood or wood structural panels attached to both the top and bottom plates in accordance with Table 3606.2.3a, or the walls shall be constructed of solid blocking.

3606.2.9 Wall bracing: Exterior and foundation wall panels of frame construction shall be braced with one-inch-by-four-inch (25 mm by 102 mm) let-in braces, or approved metal strap devices installed in accordance with the manufacturer's specifications; wood structural panels in accordance with Table ***3606.2.3b***; particleboard in accordance with Table ***3606.2.3c***, gypsum sheathing, wallboard or veneer base applied vertically or horizontally to studs spaced not more than 24 inches (610 mm) on center and fastened in accordance with Table ***3606.2.3a***; fiberboard sheathing applied vertically to studs spaced not more than 16 inches (406 mm) on center and fastened in accordance with Table ***3606.2.3a***; portland cement plaster applied over metal lath attached to studs spaced not more than 16 inches (406 mm) on center in accordance with ***780 CMR 3607.3.6***, or other approved material. If let-in bracing is used, it shall be let into the top and bottom plates and the intervening studs, placed at not more than 60 degrees or less than 45 degrees from the horizontal and attached to the framing in conformance with Table ***3606.2.3a***. Structural sheathing and one-inch-by-four-inch (25 mm by 102 mm) let-in braces shall be installed in accordance with Table ***3606.2.9*** and fastened in accordance with Table ***3606.2.3a***.

Exception: The minimum 48-inch (1219 mm) braced wall panel width required by Table ***3606.2.9*** may be replaced by an alternate braced wall panel constructed in accordance with the following:

1. In one-story buildings, each panel shall have a width of not less than 32 inches (813 mm) and a height of not more than ten feet (3048 mm). Each panel shall be sheathed on one face with ⅜-inch (9.5 mm) minimum thickness wood structural panel sheathing nailed with 8d common or galvanized box nails in accordance with Table ***3606.2.3a*** and blocked at all edges. Two anchor bolts installed in accordance with Figure ***3604.3.1a*** or approved equivalent shear connectors shall be provided in each panel. Each panel end stud shall have a tie-down device fastened to the foundation, capable of providing an approved uplift capacity of not less than 1,800 pounds (816 kg). The tie-down device shall be installed in accordance with the manufacturer's recommendations. The panels shall be supported directly on a foundation or on floor framing supported directly on a foundation. This foundation or footing shall be continuous across the entire length of the braced wall line and shall be reinforced with not less than two No. 4 bars.
2. In the first story of two-story buildings, each braced wall panel shall be constructed in accordance with 780 CMR 3606.2.9 Exception item 1, except that the wood structural panel sheathing shall be applied to both faces, three anchor bolts or approved equivalent shear connectors shall be provided, and tie-down device uplift capacity shall not be less than 3,000 pounds (1361 kg).

780 CMR 3606.3 METAL

3606.3.1 General: ***Metal structural elements in walls and partitions may be either hot-rolled structural shapes or bar sections or members cold formed to shape from sheet, strip or plate, or a fabricated combination thereof. Members shall be straight and free of any defects which would significantly affect their structural performance.***

Structural elements in walls and partitions shall be constructed of materials and designed in accordance with AA SAA30, the AISI "Specification for the Design, Fabrication and Erection of Structural Steel for Buildings", as listed in Appendix A.

780 CMR 3606.4 GENERAL MASONRY CONSTRUCTION

3606.4.1 General: Masonry construction shall be designed and constructed in accordance with the provisions of 780 CMR 3606.4 or in accordance with the provisions of ACI 530/ASCE 5/TMS 402, *as listed in Appendix A*.

TABLE 3606.2.9
WALL BRACING

CONDITION[1]	TYPE OF BRACE	AMOUNT OF BRACING[2,3]
One story Top of two story or three story. First story of two story. Second Story.	One-inch-by-four-inch let in bracing or structural sheathing.	Located at each end and at least every 25 feet of wall length
First story of three story	Structural sheathing	Miminum 48-inch-wide panels. Located as required for let-in bracing.

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm.

1. Foundation wall panels braced same as story above.
2. Where structural sheathing is used, each braced panel must be at least 48 inches in width.
3. Structural sheathing and let-in bracing shall be located at each end or as near thereto as possible.

3606.4.2 Thickness of masonry: The nominal thickness of masonry walls shall conform to the requirements of *780 CMR 3606.4.2.1* through *3606.4.2.4*.

3606.4.2.1 Minimum thickness: The minimum thickness of masonry bearing walls more than one story in height shall be eight inches (203 mm). Solid masonry walls of one story dwellings and garages shall not be less than six inches (153 mm) in thickness when not greater than nine feet (2743 mm) in height, provided that when gable construction is used, an additional six feet (1829 mm) is permitted to the peak of the gable. Masonry walls shall be laterally supported in either the horizontal or vertical direction at intervals as required by *780 CMR 3606.4.8*.

3606.4.2.2 Rubble stone masonry wall: The minimum thickness of rough, random or coursed rubble stone masonry walls shall be 16 inches (406 mm).

3606.4.2.3 Change in thickness: ***Masonry walls comprised of hollow units or of masonry bonded hollow units that decrease in thickness shall be constructed with a course of solid masonry between the wall below and the thinner wall above, or shall be constructed with special units or construction that shall transmit the loads from face shells or wythes above to those below.***

3606.4.2.4 Parapet walls: Unreinforced solid masonry parapet walls shall not be less than eight inches (203 mm) in thickness and the height of the parapet shall not exceed four times its thickness. Unreinforced hollow unit masonry parapet walls shall not be less than eight inches (203 mm) in thickness, and the height of the parapet shall not exceed three times its thickness.

3606.4.3 Corbeled masonry: Solid masonry units shall be used for corbeling. The maximum corbeled projection beyond the face of the wall shall not be more than ½ of the wall thickness or ½ the wythe thickness for hollow walls; the maximum projection of one unit shall not exceed ½the height of the unit or ⅓ the thickness at right angles to the wall. The top course of corbels shall be a header course when the corbeled masonry is used to support floor or roof-framing members.

3606.4.3.1 Support conditions: Cavity wall or masonry veneer construction may be supported on an eight-inch (203 mm) foundation wall, provided the eight-inch (203 mm) wall is corbeled with solid masonry to the width of the wall system above. The total horizontal projection of the corbel shall not exceed two inches (51 mm) with individual corbels projecting not more than ⅓ the thickness of the unit or ½ the height of the unit. The top course of all corbels shall be a header course.

3606.4.4 Allowable stresses: Allowable compressive stresses in masonry shall not exceed the values prescribed in Table *3606.4.4*. In determining the stresses in masonry, the effects of all loads and conditions of loading and the influence of all forces affecting the design and strength of the several parts shall be taken into account.

3606.4.4.1 Combined units: In walls or other structural members composed of different kinds or grades of units, materials or mortars, the maximum stress shall not exceed the allowable stress for the weakest of the combination of units, materials and mortars of which the member is composed. The net thickness of any facing unit which is used to resist stress shall not be less than 1½ inches (38 mm).

3606.4.5 Piers: The unsupported height of masonry piers shall not exceed ten times the least dimension of the pier. When structural clay tile or hollow concrete masonry units are used for isolated piers to support beams and girders, the cellular spaces shall be filled solidly with concrete or Type M or S mortar. When hollow masonry units are solidly filled with concrete or Type M, S or N mortar, the allowable compressive stress may be increased as provided in Table 3606.4.4.

Exception: Unfilled hollow piers may be used if the unsupported height of the pier is not more than four times its least dimension.

3606.4.5.1 Pier cap: Hollow piers shall be capped with four inches (102 mm) of solid masonry or concrete or the cavities of the top course shall be filled with concrete or grout or other methods approved by the building official.

TABLE 3606.4.4
ALLOWABLE COMPRESSIVE STRESSES FOR EMPIRICAL DESIGN OF MASONRY

CONSTRUCTION; COMPRESSIVE STRENGTH OF UNIT, GROSS AREA	ALLOWABLE COMPRESSIVE STRESSES[1] GROSS CROSS-SECTIONAL AREA[2]	
	Type M or S Mortar	Type N Mortar
Solid masonry of brick and other solid units of clay or shale; sand lime or concrete brick:		
8,000 + psi	350	300
4,500 psi	225	200
2,500 psi	160	140
1,500 psi	115	100
Grouted[3] masonry, of clay or shale; sand-lime or concrete:		
4,500 psi	225	200
2,500 psi	160	140
1,500 psi	115	100
Solid masonry of solid concrete masonry units:		
3,000 psi	225	200
2,000 psi	160	140
1,200 psi	115	100
Masonry of hollow load bearing units:		
2,000 psi	140	120
1,500 psi	115	100
1,000 psi	75	70
700 psi	60	55
Hollow walls (cavity or masonry bounded[4]) solid units:		
2,500 psi	160	140
1,500 psi	115	100
Hollow units	75	70
Stone ashlar masonry:		
Granits	720	640
Limestone or marble	450	400
Sandstone or cast stone	360	320
Rubble Stone Masonry:		
Coarse, rough or random	120	100

For SI: 1 psi = 6.895 kPa.

1. Linear interpolation shall be used for determining allowable stresses for masonry units having comprehensive strengths which are intermediate between those given in this table.
2. Gross cross-sectional area shall be calculated on the actual rather than nominal dimensions.
3. See 780 CMR 3606.7 Grouted Masonry.
4. Where floor and roof loads are carried upon one wythe, the gross cross-sectional area is that of the wythe under load; if both wythes are loaded, the gross cross-sectional area is that of the wall minus the area of cavity between the wythes. Walls bonded with metal ties shall be considered as cavity walls unless the collar joints are filled with mortar or grout.

3606.4.6 Chases: Chases and recesses in masonry walls shall not be deeper than ⅓ the wall thickness, and the maximum length of a horizontal chase or horizontal projection shall not exceed four feet (1219 mm), and shall have at least eight inches (203 mm) of masonry in back of the chases and recesses and between adjacent chases or recesses and the jambs of openings. Chases and recesses in masonry walls shall be designed and constructed so as not to reduce the required strength or required fire resistance of the wall and in no case shall a chase or recess be permitted within the required area of a pier. Masonry directly above chases or recesses wider than 12 inches (305 mm) shall be supported on noncombustible lintels.

3606.4.7 Stack bond: In unreinforced masonry construction where units are laid in stack bond, longitudinal reinforcement consisting of not less than two continuous wires each with a minimum aggregate cross-sectional area of 0.017 square inches (11 mm^2) shall be provided in horizontal bed joints spaced not more than 16 inches (406 mm) on center vertically.

3606.4.8 Lateral support: Masonry walls shall be laterally supported in either the horizontal or the vertical direction. The maximum spacing between lateral supports shall not exceed the distances allowed in Table *3606.4.8*. Lateral support shall be provided by cross walls, pilasters, buttresses, or structural frame members when the limiting distance is taken horizontally, or by floors or roofs when the limiting distance is taken vertically.

3606.4.8.1 Horizontal lateral support: Lateral support in the horizontal direction provided by intersecting masonry walls shall be provided by one of the methods defined in ***780 CMR 3606.4.8.1.1*** or ***3606.4.8.1.2***.

3606.4.8.1.1 Bonding pattern: 50% of the units at the intersection shall be laid in an overlapping masonry bonding pattern, with alternate units having a bearing of not less than three inches (76 mm) on the unit below.

TABLE 3606.4.8
SPACING OF LATERAL SUPPORT FOR MASONRY WALLS

CONSTRUCTION	MAXIMUM WALL LENGTH TO THICKNESS OR WALL HEIGHT TO THICKNESS[1,2]
Bearing Walls	
Solid or solid grouted	20
All others	18
Nonbearing walls	
Exterior	18
Exterior	36

For SI: 1 foot = 304.8 mm.

1. Except for cavity walls and cantilevered walls, the thickness of a wall shall be its nominal thickness measured perpendicular to the face of the wall. For cavity walls, the thickness shall be determined as the sum of the nominal thicknesses of the individual wythes. For cantilever walls, except for parapets, the ratio of the height to nominal thickness shall not exceed six for solid masonry, or four for hollow masonry. For parapets, see 780 CMR 3606.4.2.4.
2. An additional unsupported height of six feet is permitted for gable end walls.

3606.4.8.1.2 Metal reinforcement: Interior nonload-bearing walls shall be anchored at their intersections, at vertical intervals of not more than 16 inches (406 mm) with joint reinforcement of at least 9 gage, or ¼ inch (6.4 mm) galvanized mesh hardware cloth. Intersecting masonry walls, other than interior nonloadbearing walls, shall be anchored at vertical intervals of not more than eight inches (203 mm) with joint reinforcement of at least 9 gage and shall extend at least 30 inches (762 mm) in each direction at the intersection. Other metal ties, joint reinforcement or anchors, if used, shall be spaced to provide equivalent area of anchorage to that required by 780 CMR 3606.4.8.

3606.4.8.2 Vertical lateral support: Vertical lateral support of masonry walls shall be provided in accordance with one of the methods in 780 CMR 3606.4.8.2.1 or 3606.4.8.2.2.

3606.4.8.2.1 Roof structures: Masonry walls shall be anchored to roof structures with metal strap anchors, ½-inch (12.7 mm) bolts, or other approved anchors spaced not more than six feet (1829 mm) on center. Anchors shall be embedded at least 16 inches (406 mm) into the masonry, or be hooked or welded to bond beam reinforcement placed not less than six inches (153 mm) from the top of the wall.

3606.4.8.2.2 Floor diaphragms: Masonry walls shall be anchored to floor diaphragms at intervals not to exceed six feet (1829 mm). Support shall be provided by metal strap anchors or ½-inch-diameter (12.7 mm) bolts installed as shown in Figure ***3606.4.10a***, or by other approved methods.

3606.4.9 Lintels: Masonry over openings shall be supported by steel lintels, reinforced concrete or masonry lintels or masonry arches, designed to support load imposed.

3606.4.10 Anchorage. Masonry walls shall be anchored to floor and roof systems in accordance with the details shown in Figure ***3606.4.10a***, ***3606.4.10b*** or ***3606.4.10c***. Footings may be considered as points of lateral support.

3606.4.11 Reinforcement: Masonry walls subject to wind loads of 30 pounds per square foot (1.44 kN/m^2) or greater, shall be constructed in accordance with the requirements of 780 CMR 3606.4.11 and Figures ***3606.4.10b*** and ***3606.4.10c***. In addition, the minimum area of reinforcement shall not be less than 0.002 times the gross cross-sectional area of the wall, not more than ⅔ of which may be used in either direction. No required vertical reinforcement shall be less than ⅜ inch (9.5 mm) in diameter. Principal wall reinforcement shall have a maximum spacing of four feet (1219 mm) on center.

3606.4.12 Protection for reinforcement: All bars shall be completely embedded in mortar or grout. Joint reinforcement embedded in horizontal mortar joints shall not have less than ⅝-inch (15.9 mm) mortar coverage from the exposed face. All other reinforcement shall have a minimum coverage of one bar diameter over all bars, but not less than ¾ inch (19 mm). Where exposed to weather or soil, the minimum coverage shall be two inches (51 mm).

3606.4.13 Beam supports: Beams, girders or other concentrated loads supported by a wall or column shall have a bearing of at least three inches (76 mm) in length measured parallel to the beam upon solid masonry not less than four inches (102 mm) in thickness, or upon a metal bearing plate of adequate design and dimensions to distribute the load safely, or upon a continuous reinforced masonry member projecting not less than four inches (102 mm) from the face of the wall.

3606.4.13.1 Joist bearing: Joists shall have a bearing of not less than 1½ inches (38 mm), except as provided in ***780 CMR 3606.4.13***, and shall be supported in accordance with Figures ***3606.4.10b*** and ***3606.4.10c***.

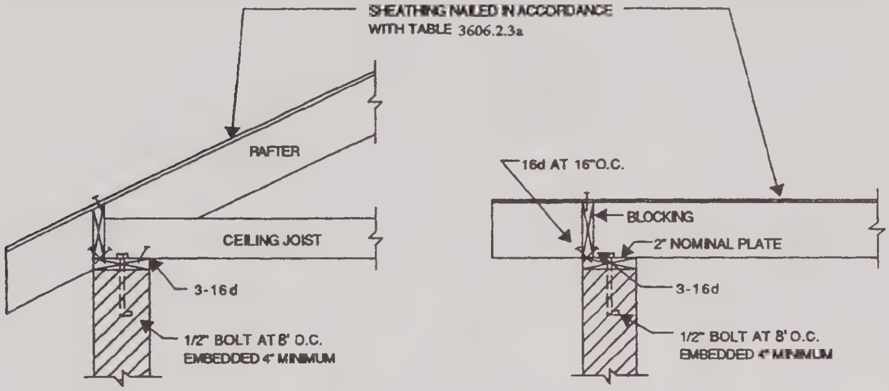
3606.4.14 Metal accessories: Joint reinforcement, anchors, ties and wire fabric shall conform to the following ***reference standards as listed in Appendix A***: ASTM A 82 for joint reinforcement, wire anchors and ties; ASTM A 36 for plate, headed and bent-bar anchors; ASTM A 510 for corrugated sheet metal anchors and ties; ASTM B 227 for copper-clad steel wire ties or ASTM A 167 for stainless steel hardware.

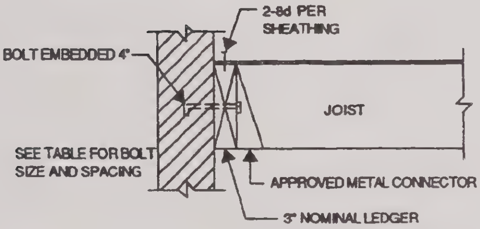
3606.4.14.1 Corrosion protection: Minimum corrosion protection of joint reinforcement, anchor ties and wire fabric for use in masonry wall construction shall conform to Table *3606.4.14.1*.

TABLE 3606.4.14.1
MINIMUM CORROSION PROTECTION

MASONRY METAL ACCESSORY	STANDARD
Joint reinforcement, interior walls	ASTM A 641, Class 1
Wire ties or anchors in exterior walls completely embedded in mortor or grout	ASTM A 641, Class 3
Wire ties or anchors in exterior walls not completely embedded in mortor or grout	ASTM A 153, Class B-2
Joint reinforcement in exterior walls or interior walls exposed to moist environment	ASTM A 153, Class B-2
Sheet metal ties or anchors exposed to weather	ASTM A 153, Class B-2
Sheet metal ties or anchors completely embedded in mortar or grout	ASTM A 525, Class G-60
Stainless steel hardware for any exposure	ASTM A 167, Type 304

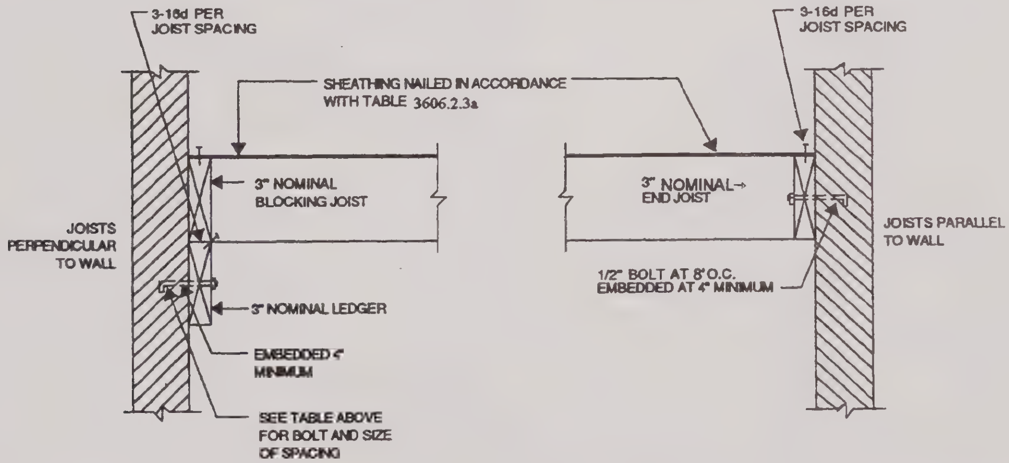
FIGURE 3606.4.10a
ANCHORAGE REQUIREMENTS FOR MASONRY WALLS


SHEATHING NAILED IN ACCORDANCE WITH TABLE 3606.2.3a
RAFTER
CEILING JOIST
3-16d
1/2" BOLT AT 8' O.C. EMBEDDED 4" MINIMUM
16d AT 16" O.C.
BLOCKING
2" NOMINAL PLATE
3-16d
1/2" BOLT AT 8' O.C. EMBEDDED 4" MINIMUM


2-8d PER SHEATHING
BOLT EMBEDDED 4"
JOIST
SEE TABLE FOR BOLT SIZE AND SPACING
APPROVED METAL CONNECTOR
3" NOMINAL LEDGER

LEDGER BOLT
SIZE AND SPACING

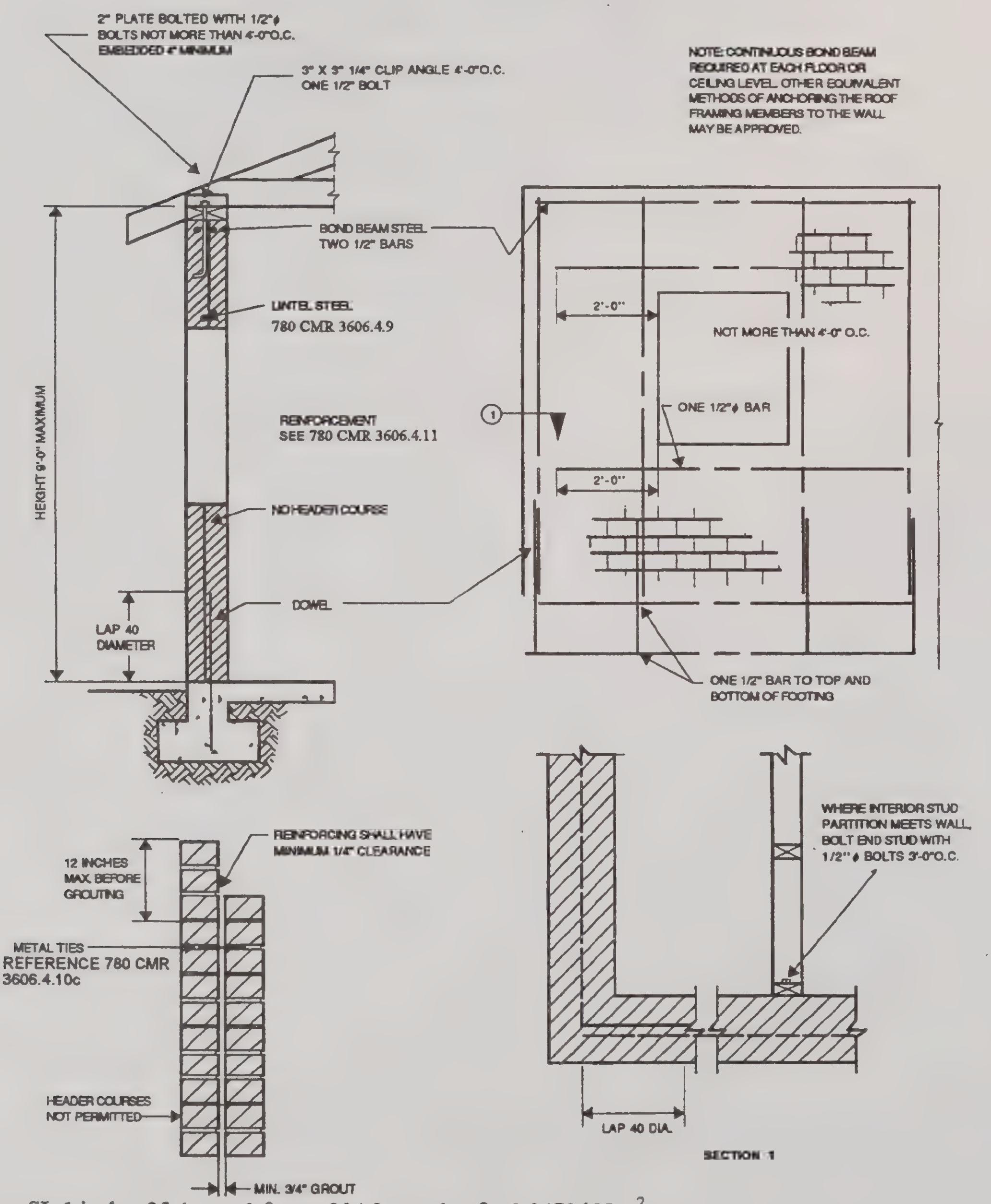
JOIST SPAN	BOLT SIZE AND SPACING	
	Roof	Floor
10′	$^1/_2$ @ 2′-6″ $^7/_8$ @ 3′-6″	$^1/_2$ @ 2′-0″ $^7/_8$ @ 2′-9″
10′-15′	$^1/_2$ @ 1′-9″ $^7/_8$ @ 2′-6″	$^1/_2$ @ 1′-4″ $^7/_8$ @ 2′-0″
15′-20′	$^1/_2$ @ 1′-3″ $^7/_8$ @ 2′-0″	$^1/_2$ @ 1′-0″ $^7/_8$ @ 1′-6″


3-16d PER JOIST SPACING
SHEATHING NAILED IN ACCORDANCE WITH TABLE 3606.2.3a
3" NOMINAL BLOCKING JOIST
JOISTS PERPENDICULAR TO WALL
3" NOMINAL LEDGER
EMBEDDED 4" MINIMUM
SEE TABLE ABOVE FOR BOLT AND SIZE OF SPACING
3-16d PER JOIST SPACING
3" NOMINAL END JOIST
JOISTS PARALLEL TO WALL
1/2" BOLT AT 8' O.C. EMBEDDED AT 4" MINIMUM

WHERE BOLTS ARE LOCATED IN HOLLOW MASONRY, THE CELLS IN THE COURSES RECEIVING THE BOLTS SHALL BE GROUTED SOLID.

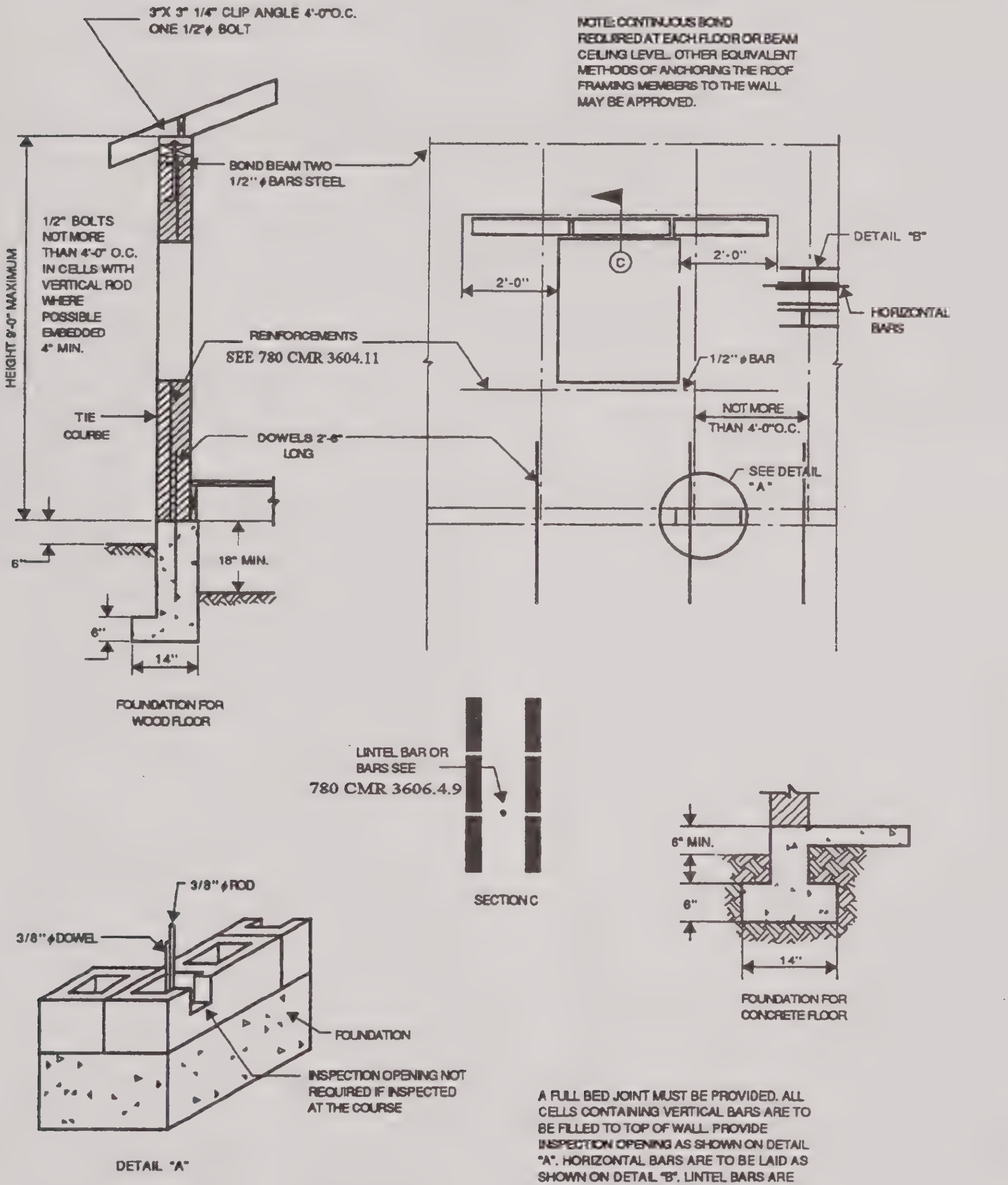
For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 psf = 0.0479 kN/m^2

FIGURE 3606.4.10b
REQUIREMENTS FOR REINFORCED GROUTED MASONRY CONSTRUCTION WHERE WIND LOADS ARE 30 PSF OR GREATER


2" PLATE BOLTED WITH 1/2"ϕ BOLTS NOT MORE THAN 4'-0"O.C. EMBEDDED 4" MINIMUM
3" X 3" 1/4" CLIP ANGLE 4'-0"O.C. ONE 1/2" BOLT
NOTE: CONTINUOUS BOND BEAM REQUIRED AT EACH FLOOR OR CEILING LEVEL. OTHER EQUIVALENT METHODS OF ANCHORING THE ROOF FRAMING MEMBERS TO THE WALL MAY BE APPROVED.
BOND BEAM STEEL TWO 1/2" BARS
LINTEL STEEL 780 CMR 3606.4.9
2'-0"
NOT MORE THAN 4'-0" O.C.
HEIGHT 9'-0" MAXIMUM
REINFORCEMENT SEE 780 CMR 3606.4.11
①
ONE 1/2"ϕ BAR
2'-0"
NO HEADER COURSE
DOWEL
LAP 40 DIAMETER
ONE 1/2" BAR TO TOP AND BOTTOM OF FOOTING
REINFORCING SHALL HAVE MINIMUM 1/4" CLEARANCE
12 INCHES MAX. BEFORE GROUTING
METAL TIES REFERENCE 780 CMR 3606.4.10c
HEADER COURSES NOT PERMITTED
MIN. 3/4" GROUT
WHERE INTERIOR STUD PARTITION MEETS WALL, BOLT END STUD WITH 1/2"ϕ BOLTS 3'-0"O.C.
LAP 40 DIA.
SECTION 1

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 psf = 0.0479 kN.m^2.

FIGURE 3606.4.10c
REQUIREMENTS FOR REINFORCED HOLLOW-UNIT MASONRY CONSTRUCTION WHERE WIND LOADS ARE 30 PSF OR GREATER


3"X 3" 1/4" CLIP ANGLE 4'-0"O.C.
ONE 1/2"ϕ BOLT
BOND BEAM TWO 1/2"ϕ BARS STEEL
1/2" BOLTS NOT MORE THAN 4'-0" O.C. IN CELLS WITH VERTICAL ROD WHERE POSSIBLE EMBEDDED 4" MIN.
HEIGHT 8'-0" MAXIMUM
REINFORCEMENTS SEE 780 CMR 3604.11
TIE COURSE
DOWELS 2'-6" LONG
6"
18" MIN.
6"
14"
FOUNDATION FOR WOOD FLOOR
C
2'-0"
2'-0"
DETAIL "B"
HORIZONTAL BARS
1/2"ϕ BAR
NOT MORE THAN 4'-0"O.C.
SEE DETAIL "A"
LINTEL BAR OR BARS SEE 780 CMR 3606.4.9
SECTION C
6" MIN.
6"
14"
FOUNDATION FOR CONCRETE FLOOR
3/8"ϕ ROD
3/8"ϕ DOWEL
FOUNDATION
INSPECTION OPENING NOT REQUIRED IF INSPECTED AT THE COURSE
DETAIL "A"

NOTE: CONTINUOUS BOND REQUIRED AT EACH FLOOR OR BEAM CEILING LEVEL. OTHER EQUIVALENT METHODS OF ANCHORING THE ROOF FRAMING MEMBERS TO THE WALL MAY BE APPROVED.

A FULL BED JOINT MUST BE PROVIDED. ALL CELLS CONTAINING VERTICAL BARS ARE TO BE FILLED TO TOP OF WALL. PROVIDE INSPECTION OPENING AS SHOWN ON DETAIL "A". HORIZONTAL BARS ARE TO BE LAID AS SHOWN ON DETAIL "B". LINTEL BARS ARE TO BE LAID AS SHOWN ON SECTION "C".

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 psf = 0.0479 kN/m^2.

780 CMR 3606.5 UNIT MASONRY

3606.5.1 Placing mortar and masonry units:

3606.5.1.1 Bed and head joints: Unless otherwise required or indicated on the project drawings, head and bed joints shall be ⅜ inch (9.5 mm) thick, except that the thickness of the bed joint of the starting course placed over foundations shall not be less than ¼ inch (6.4 mm) and not more than ¾ inch (19 mm).

3606.5.1.1.1 Mortar joint thickness tolerance: Mortar joint thickness shall be within the following tolerances from the specified dimensions:

bed joint	±⅛ inch (3.2 mm)
head joint	-¼ inch (6.4 mm), +⅜ inch (9.5 mm)
collar joints	-¼ inch (6.4 mm), +⅜ inch (9.5 mm)

Exception: Nonload-bearing masonry elements and masonry veneers designed and constructed in accordance with ***780 CMR 3607.3.7*** are not required to meet these tolerances.

3606.5.1.2 Masonry unit placement: The mortar shall be sufficiently plastic and units shall be placed with sufficient pressure to extrude mortar from the joint and produce a tight joint. Deep furrowing of bed joints which produces voids shall not be permitted. Any units disturbed to the extent that the initial bond is broken after initial placement shall be removed and relaid in fresh mortar. Surfaces to be in contact with mortar shall be clean and free of deleterious materials.

3606.5.1.2.1 Solid masonry: All solid masonry units shall be laid with full head and bed joints and all interior vertical joints that are designed to receive mortar shall be filled solid.

3606.5.1.2.2 Hollow masonry: ***All head and bed joints of hollow masonry units*** shall be filled solidly with mortar. ***The mortar shall extend a distance from the face of the masonry unit that shall measure not less than the thickness of the face shell.***

3606.5.2 Installation of wall ties: The installation of wall ties shall be as follows:

1. The ends of wall ties shall be embedded in mortar joints. Wall tie ends shall engage outer face shells of hollow units by at least ½ inch (12.7 mm). Wire wall ties shall be embedded at least 1½ inches (38 mm) into the mortar bed of solid masonry units or solid grouted hollow units.
2. Wall ties shall not be bent after being embedded in grout or mortar.

780 CMR 3606.6 MULTIPLE WYTHE MASONRY

3606.6.1 General: The facing and backing of multiple wythe masonry walls shall be bonded in accordance with ***780 CMR 3606.6.1.1, 3606.6.1.2 or 3606.6.1.3***. In cavity walls, neither the facing nor the backing shall be less than three inches (76 mm) nominal in thickness and the cavity shall not be more than four inches (102 mm) nominal in width. The backing shall be at least as thick as the facing.

Exception: Cavities may exceed the four-inch (102 mm) nominal dimension provided tie size and tie spacing have been established by calculation.

3606.6.1.1 Bonding with masonry headers: Bonding with solid or hollow masonry headers shall comply with ***780 CMR 3606.6.1.1.1*** and ***3606.6.1.1.2***.

3606.6.1.1.1 Solid units: Where the facing and backing (adjacent wythes) of solid masonry construction are bonded by means of masonry headers, no less than 4% of the wall surface of each face shall be composed of headers extending not less than three inches (76 mm) into the backing. The distance between adjacent full-length headers shall not exceed 24 inches (610 mm) either vertically or horizontally. In walls in which a single header does not extend through the wall, headers from the opposite sides shall overlap at least three inches (76 mm), or headers from opposite sides shall be covered with another header course overlapping the header below at least three inches (76 mm).

3606.6.1.1.2 Hollow units: Where two or more hollow units are used to make up the thickness of a wall, the stretcher courses shall be bonded at vertical intervals not exceeding 34 inches (864 mm) by lapping at least three inches (76 mm) over the unit below, or by lapping at vertical intervals not exceeding 17 inches (432 mm) with units which are at least 50% greater in thickness than the units below.

3606.6.1.2 Bonding with wall ties or joint reinforcement: Bonding with wall ties or joist reinforcement shall comply with ***780 CMR 3606.6.1.2.1*** through ***3606.6.1.2.3***.

3606.6.1.2.1 Bonding with wall ties: Bonding with wall ties, except as required by ***780 CMR 3606.6.1.2.2***, where the facing and backing (adjacent wythes) of masonry walls are bonded with 3/16-inch-diameter (4.8 mm) wall ties embedded in the horizontal mortar joints, there shall be at least one metal tie for each 4½ square feet (0.418 m^2) of wall area. Ties in alternate courses shall be staggered. The maximum vertical distance between ties shall not exceed 24 inches (610 mm), and the maximum horizontal distance shall not exceed 36 inches (914 mm). Rods or ties bent to rectangular shape shall be used with hollow masonry units laid with the cells vertically. In other walls, the ends of ties shall be bent to 90-

degree angles to provide hooks no less than two inches (51 mm) long. Additional bonding ties shall be provided at all openings, spaced not more than three feet (914 mm) apart around the perimeter and within 12 inches (305 mm) of the opening.

3606.6.1.2.2 Bonding with adjustable wall ties: Where the facing and backing (adjacent wythes) of masonry are bonded with adjustable wall ties, there shall be at least one tie for each 2⅔ square feet (0.248 m^2) of wall area. Neither the vertical nor horizontal spacing of the adjustable wall ties shall exceed 24 inches (610 mm). The maximum vertical offset of bed joints from one wythe to the other shall be 1¼ inches (32 mm). The maximum clearance between connecting parts of the ties shall be $^1/_{16}$ inch (1.6 mm). When pintle legs are used, ties shall have at least two $^3/_{16}$-inch-diameter (4.8 mm) legs.

3606.6.1.2.3 Bonding with prefabricated joint reinforcement: Where the facing and backing (adjacent wythes) of masonry are bonded with prefabricated joint reinforcement, there shall be at least one cross wire serving as a tie for each 2⅔ square feet (0.248 m^2) of wall area. The vertical spacing of the joint reinforcement shall not exceed 16 inches (406 mm). Cross wires on prefabricated joint reinforcement shall not be smaller than No. 9 gage. The longitudinal wires shall be embedded in the mortar.

3606.6.1.3 Bonding with natural or cast stone: Bonding with natural and cast stone shall conform to ***780 CMR 3606.6.1.3.1*** and ***3606.6.1 3.2***.

3606.6.1.3.1 Ashlar masonry: Bonder units in ashlar masonry that are uniformly distributed, shall be provided to the extent of not less than 10% of the wall area. Such bonder units shall extend not less than four inches (102 mm) into the backing wall.

3606.6.1.3.2 Rubble stone masonry: Rubble stone masonry 24 inches (610 mm) or less in thickness shall have bonder units with a maximum spacing of three feet (914 mm) vertically and three feet (914 mm) horizontally, and if the masonry is of greater thickness than 24 inches (610 mm), shall have one bonder unit for each six square feet (0.557 m^2) of wall surface on both sides.

3606.6.2 Masonry bonding pattern: Masonry laid in running and stack bond shall conform to ***780 CMR 3606.6.2.1*** and ***3606.6.2.2***.

3606.6.2.1 Masonry laid in running bond: In each wythe of masonry laid in running bond, head joints in successive courses shall be offset by not less than one-fourth the unit length, or the masonry walls shall be reinforced longitudinally as required in ***780 CMR 3606.6.2.2***.

3606.6.2.2 Masonry laid in stack bond: Where unit masonry is laid with less head joint offset than in 780 CMR ***3606.6.2.1***, the minimum area of horizontal reinforcement placed in mortar bed joints or in bond beams spaced not more than 48 inches (1219 mm) apart, shall be 0.0007 times the vertical cross-sectional area of the wall.

780 CMR 3606.7 GROUTED MASONRY

3606.7.1 General: Grouted multiple-wythe masonry is a form of construction in which the space between the wythes is solidly filled with grout. It is not necessary for the cores of masonry units to be filled with grout. Grouted hollow unit masonry is a form of construction in which certain cells of hollow units are continuously filled with grout.

3606.7.1.1 Mortar and grout: Only Type M or Type S mortar mix consisting of portland cement, hydrated lime and sand in accordance with ASTM C 270, ***listed in Appendix A***, and the proportion specifications of Table ***3606.7.1.1a*** shall be used to construct masonry wythes. Grout shall consist of cementitious material and aggregate in accordance with ASTM C 476, ***listed in Appendix A***, and the proportion specifications of Table ***3606.7.1.1b***. Type M or Type S mortar to which sufficient water has been added to produce pouring consistency can be used as grout.

TABLE 3606.7.1.1a
MORTAR PROPORTIONS[1,2]

PROPORTIONS BY VOLUME (Cementitious Materials)							
Mortar	**Type**	**Protland Cement or Blended Cement**	**Masonry Cement**			**Hydrated Lime or Lime Putty**	**Aggregate Ratio (Measured in Damp, Loose Conditions)**
			M	**S**	**N**		
Cement-lime	M	1	-	-	-	¼	Not less than 2¼ and not more than three times the sum of separate volumes of lime, if used, and cement
	S	1	-	-	-	over ¼ to ½	
	N	1	-	-	-	over ½ to 1¼	
	O	1	-	-	-	over 1¼ to 2½	
Masonry cement	M	1	-	-	1		
	M	-	1	-	-		
	S	½	-	-	1		
	S	-	-	1	-		
	N	-	-	-	1		
	O	-	-	-	1		

For SI: 1 cubic foot = 0.0283 m^3, 1 pound = 0.454 kg.

1. For the purpose of these specifications, the weight of one cubic foot of the respective materials shall be considered to be as follows:
   Portland Cement94 lb.
   Masonry cementWeight printed on bag
   Hydrated lime40 lb.
   Lime putty(quicklime)80 lb.
   Sand, damp and loose80 lb. of dry sand
2. Two air-entraining materials shall not be combined in mortar.

TABLE 3606.7.1.1b
GROUT PROPORTIONS BY VOLUME FOR MASONRY CONSTRUCTION

TYPE	**PORTLAND CEMENT OR BLENDED CEMENT SLAG CEMENT**	**HYDRATED LIME OR LIME PUTTY**	**AGGREGATE MEASURED IN A DAMP, LOOSE CONDITION**	
			Fine	**Coarse**
Fine	1	0 to $^1/_{10}$	2¼ to three times the sum of the volume of the cementitious materials	-
Coarse	1	0 to $^1/_{10}$	2¼ to three times the sum of the volume of the cementitious materials	One to two times the sum of the volumes of the cementitious materials

3606.7.1.2 Grouting requirements: Maximum pour heights and the minimum dimensions of spaces provided for grout placement shall conform to Table *3606.7.1.2*. If the work is stopped for one hour or longer, the horizontal construction joints shall be formed by stopping all tiers at the same elevation and with the grout one inch (25 mm) below the top.

TABLE 3606.7.1.2
GROUT SPACE DIMENSIONS AND POUR HEIGHTS

GROUT TYPE	**GROUT POUR MAXIMUM HEIGHT (feet)**	**MINIMUM WIDTH OF GROUT SPACES[1,2] (inches)**	**MINIMUM GROUT[2,3] SPACE DIMENSIONS FOR GROUTING CELLS OF HOLLOW UNITS (inches = 43 inches)**
Fine	1	¾	1½ x 2
	5	2	2 x 3
	12	2½	2½ x 3
	24	3	3 x 3
Coarse	1	1½	1½ x 3
	5	2	2½ x 3
	12	2½	3 x 3
	24	3	3 x 4

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm.

1 For grouting between masonry wythes.

2. Grout space dimension is the clear dimension between any masonry protrusion and shall be increased by the horizontal projection of the diameters of the horizontal bars within the cross section of the grout space.

3. Area of vertical reinforcement shall not exceed 6% of the area of the grout space.

3606.7.1.3 Grout space (cleaning): Provision shall be made for cleaning grout space. Mortar projections which project more than ½ inch (12.7 mm) into grout space and any other foreign matter shall be removed from grout space prior to inspection and grouting.

3606.7.1.4 Grout placement: Grout shall be a plastic mix suitable for pumping without segregation of the constituents and shall be mixed thoroughly. Grout shall be placed by pumping or by an approved alternate method and shall be placed before any initial set occurs and in no case more than 1½ hours after water has been added. Grouting shall be done in a continuous pour, in lifts not exceeding four feet (1219 mm). It shall be consolidated by puddling or mechanical vibrating during placing and reconsolidated after excess moisture has been absorbed but before plasticity is lost.

3606.7.1.4.1 Grout pumped through aluminum pipes: Grout shall not be pumped through aluminum pipes.

3606.7.1.5 Cleanouts: Where required by the building official, cleanouts shall be provided as specified in 780 CMR 3606.7.1.5. The cleanouts shall be sealed before grouting and after inspection.

3606.7.1.5.1 Grouted multiple-wythe masonry: Cleanouts shall be provided at the bottom course of the exterior wythe at each pour of grout where such pour exceeds five feet (1524 mm) in height.

3606.7.1.5.2 Grouted hollow unit masonry: Cleanouts shall be provided at the bottom course of each cell to be grouted at each pour of grout, where such pour exceeds four feet (1219 mm) in height.

3606.7.1.6 Inspection: Special inspection during grouting shall be provided where required by the building official.

3606.7.2 Grouted multiple-wythe masonry: Grouted multiple-wythe masonry shall conform to all the requirements specified in ***780 CMR 3606.7.1*** and the requirements of 780 CMR 3606.7.2.

3606.7.2.1 Bonding of backup wythe: Where all interior vertical spaces are filled with grout in multiple-wythe construction, masonry headers shall not be permitted. Metal wall ties shall be used in accordance with ***780 CMR 3606.6.1.2*** to prevent spreading of the wythes and to maintain the vertical alignment of the wall. Wall ties shall be installed in accordance with ***780 CMR 3606.6.1.2***, when the backup wythe in multiple-wythe construction is fully grouted.

3606.7.2.2 Grout spaces: Fine grout shall be used when interior vertical space to receive grout does not exceed two inches (51 mm) in thickness. Interior vertical spaces exceeding two inches (51 mm) in thickness shall use course or fine grout.

3606.7.2.3 Grout barriers: Vertical grout barriers or dams shall be built of solid masonry across the grout space the entire height of the wall to control the flow of the grout horizontally. Grout barriers shall not be more than 25 feet (7620 mm) apart. The grouting of any section of a wall between control barriers shall be completed in one day with no interruptions greater than one hour.

3606.7.3 Reinforced grouted multiple-wythe masonry: Reinforced grouted multiple-wythe masonry shall conform to all the requirements specified in ***780 CMR 3606.7.1*** and ***3606.7.2*** and the requirements of 780 CMR 3606.7.3

3606.7.3.1 Construction: The thickness of grout or mortar between masonry units and reinforcement shall not be less than ¼ inch (6.4 mm), except that ¼-inch (6.4 mm) bars may be laid in horizontal mortar joints at least ½ inch (12.7 mm) thick, and steel wire reinforcement may be laid in horizontal mortar joints at least twice the thickness of the wire diameter.

3606.7.4 Reinforced hollow unit masonry: Reinforced hollow unit masonry shall conform to all the requirements of ***780 CMR 3606.7.1*** and the requirements of 780 CMR 3606.7.4.

3606.7.4.1 Construction: Requirements for construction shall be as follows:

1. All reinforced hollow-unit masonry shall be built to preserve the unobstructed vertical continuity of the cells to be filled. Walls and cross webs forming such cells to be filled shall be full-bedded in mortar to prevent leakage of grout. All head and end joints shall be solidly filled with mortar for a distance in from the face of the wall or unit not less than the thickness of the longitudinal face shells. Bond shall be provided by lapping units in successive vertical courses.
2. Cells to be filled shall have vertical alignment sufficient to maintain a clear, unobstructed continuous vertical cell of dimensions prescribed in Table ***3606.7.1.2***.
3. Vertical reinforcement shall be held in position at top and bottom and at intervals not exceeding 200 diameters of the reinforcement.
4. All cells containing reinforcement shall be filled solidly with grout. Grout shall be poured in lifts of eight-foot (2438 mm) maximum height. When total grout pour exceeds eight feet (2438 mm) in height, the grout shall be placed in lifts not exceeding four feet (1219 mm) and special inspection during grouting shall be required.
5. Horizontal steel shall be fully embedded by grout in an uninterrupted pour.

780 CMR 3606.8 WINDOWS

3606.8.1 Testing and certification: Windows shall be tested and certified to indicate compliance with the requirements of the following specifications:

Aluminum: AAMA (ANSI) 101
Wood: ANSI/NWWDA I.S. 2
Polyvinyl Chloride: ASTM D 4099, ***each as listed in Appendix A***.

3606.8.2 Air infiltration: Regardless of the type or requirements of the windows set forth in the aforementioned specifications, no window may be selected whose air infiltration exceeds 0.50 cubic feet per minute per linear foot (0.236 L/s per mm) of crack when tested in accordance with ASTM E 283, ***as listed in Appendix A***, at a pressure differential of 1.56 psf (0.075 kN/m^2).

780 CMR 3606.9 SLIDING GLASS DOORS

3606.9.1 Testing and certification: Sliding glass doors shall be tested and certified to indicate compliance with the requirements of the following specifications:

Aluminum: AAMA (ANSI) 101
Wood: ANSI/NWWDA I.S.3, ***each as listed in Appendix A***.

3606.9.2 Air infiltration: Regardless of the type or requirements of the sliding glass doors set forth in the aforementioned specifications, no sliding glass door may be selected whose air infiltration exceeds 0.50 cubic feet per minute per square foot (0.236 L/s per mm^2) of door area when tested in accordance with ASTM E 283, ***as listed in Appendix A,*** at a pressure differential of 1.56 pounds per square foot (0.075kN/m^2).

780 CMR 3606.10 PLYWOOD AND WOOD STRUCTURAL PANELS

3606.10.1 Identification and grade: Plywood shall conform to DOC PS 1, DOC PS 2 or HPMA (ANSI) HP, ***as listed in Appendix A***. Wood structural panels shall conform to DOC PS 2, ***as listed in Appendix A***. All panels shall be identified by a grade mark or certificate of inspection issued by an approved agency. Wood structural panels shall comply with the grades specified in Table ***3606.2.3b***.

3606.10.2 Allowable spans: The maximum allowable spans for wood structural panel wall sheathing shall not exceed the values set forth in Table ***3606.2.3b***.

3606.10.3 Installation: Wood structural panel wall sheathing shall be attached to framing in accordance with Table ***3606.2.3a***. Wood structural panels marked Exposure 1 or Exterior are considered water-repellent sheathing under 780 CMR.

780 CMR 3606.11 PARTICLEBOARD

3606.11.1 Identification and grade: Particleboard shall conform to ANSI A208.1, ***as listed in Appendix A,*** and shall be so identified by a grade mark or certificate of inspection issued by an approved agency. Particleboard shall comply with the grades specified in Table ***3606.2.3c***.

WALL COVERING

780 CMR 3607.1 - GENERAL

3607.1.1 Application: The provisions of 780 CMR 3607.1 shall control the design and construction of the interior and exterior wall covering for all buildings. The use of materials or methods of construction not specified in 780 CMR 3607.1 accomplishing the purposes intended by 780 CMR 36 and approved by the building of in accordance with ***780 CMR 109*** shall be accepted as complying with 780 CMR 36.

3607.1.2 Installation: Products sensitive to adverse weather shall not be installed until adequate weather protection for the installation is provided. Exterior sheathing shall be dry before applying exterior cover.

780 CMR 3607.2 INTERIOR COVERING

3607.2.1 General: Interior coverings shall be installed in accordance with this ***section*** and Tables ***3607.2.1a, 3607.2.1b, 3607.2.1c and 3607.2.3.4.*** Interior finishes and materials shall conform to the flame spread and smoke-density requirements of ***780 CMR 3603***.

3607.2.2 Interior plaster: Gypsum plaster or portland cement plastering materials shall conform to ASTM C 5, C 28, C 35, C 37, C 59, C 61, C 587, C 588, C 631, C847, C 897, C 933, C 1032 and C 1047, and shall be installed or applied in conformance with ASTM C 843, C 844 and C 1063, ***each as listed in Appendix A***. Plaster shall not be less than three coats when applied over metal lath and not less than two coats when applied over other bases permitted by 780 CMR 3607.2, except that veneer plaster may be applied in one coat not to exceed $^{3}/_{16}$ inch (4.76 mm) thickness, provided the total thickness is as set forth in Table ***3607.2.1a***.

3607.2.2.1 Support: Support spacing, ***spacing of fasteners and size of fasteners*** for gypsum and metal lath shall conform with Table ***3607.2.3.4***. Gypsum lath shall be installed at right angles to support framing with end joints staggered.

3607.2.3 Gypsum wallboard:

3607.2.3.1 Materials: All gypsum wallboard materials and accessories shall conform to ASTM C 36, C 475, C 514, C 960, C 1002 and C 1047 ***as listed in Appendix A***, and shall be installed in accordance with the provisions of 780 CMR 3607.2. Adhesives for the installation of gypsum wallboard shall conform to ASTM C 557 ***as listed in Appendix A***.

3607.2.3.2 Wood framing: Wood framing supporting gypsum wallboard shall not be less than two inches (51 mm) nominal thickness in the least dimension except that wood furring strips not less than one-inch-by-two inch (25 mm by 51 mm) nominal dimension may be used over solid backing or framing spaced not more than 24 inches (610 mm) on center.

3607.2.3.3 Steel framing: Steel framing shall not be less than 1¼ inches (32 mm) wide in the least dimension. Light-gage nonload-bearing steel framing shall comply with ASTM C 645 ***as listed in Appendix A***. Load-bearing steel framing and steel framing from 0.033 inch to 0.112 inch (0.838 mm to 2.84 mm) thick shall comply with ASTM C 955 ***as listed in Appendix A***.

3607.2.3.4 Application: Support spacing and size and spacing of fasteners shall comply with Table ***3607.2.3.4***. Gypsum wallboard may be applied at right angles or parallel to framing members. All edges and ends of gypsum wallboard shall occur on the framing members, except those edges and ends which are perpendicular to the framing members. Interior gypsum wallboard shall not be installed where it is exposed to the weather construction.

3607.2.3.5 Fastening: Screws for attaching gypsum wallboard to wood shall be Type W in accordance with ASTM C 1002 ***as listed in Appendix A*** and shall penetrate the wood not less than ⅝ inch (15.9 mm). Screws for attaching gypsum wallboard to light-gage steel shall be Type S in accordance with ASTM C 1002 ***as listed in Appendix A*** and shall penetrate the steel not less than ¼ inch (6.4 mm). Screws for attaching gypsum wallboard to steel 0.033 inch to 0.112 inch (0.838 mm to 2.84 mm) thick shall comply with ASTM C 954 ***as listed in Appendix A***.

3607.2.4 Bathtub and shower spaces: Bathtub and shower floors and walls shall be finished with a smooth, hard and nonabsorbent surface. Ceramic tile surfaces shall be installed in accordance with ANSI A 108.1, A108.4, A108.5, A108.6, A108.11, A118.1, A 118.3, A 136.1 and A 137.1 ***as listed in Appendix A***. Such wall surfaces shall extend to a height of not less than six feet (1829 mm) above the floor.

3607.2.4.1 Ceramic tile: Gypsum board utilized as the base or backer board for adhesive application of ceramic tile or other nonabsorbent finish material shall conform with ASTM C 630 ***as listed in Appendix A***. Water-resistant gypsum backing board shall be permitted to be used on ceilings where framing spacing does not exceed 12 inches (305 mm) on center. All cut or exposed edges, including those at wall intersections, shall be sealed as recommended by the manufacturer.

3607.2.5 Other finishes: Wood veneer or hardboard paneling not less than ¼-inch (6.4 mm) nominal thickness [$^{13}/_{64}$-inch (5.2 mm) actual] shall conform to HPMA (ANSI) HP for wood veneer and AHA (ANSI) A135.5 for hardboard paneling. These finishes may be installed directly to studs with a maximum 16 inches on center spacing: wood veneer or hardboard paneling less than ¼ inch nominal thickness must not have less than ⅜ inch gypsum board backer, unless the qualifying tests were made with the material suspended from noncombustible backing, and stud spacing may not exceed 16 inches on center.

3607.2.6 Wood shakes and shingles: Wood shakes and shingles shall conform to CSSB "Grading Rules for Wood Shakes and Shingles" ***as listed in Appendix A.***

TABLE 3607.2.1a
THICKNESS OF PLASTER

PLASTER BASE	FINISHED THICKNESS OF PLASTER FROM FACE TO LATH, MASONRY, CONCRETE	
	Gypsum Plaster	Portland Cement Mortar
Expanded metal lath	⅝″ minimum[1]	⅝″ minimum[1]
Wire lath	⅝″ minimum[1]	¾″ minimum (interior)[2] ⅞″ minimum (exterior)[2]
Gypsum lath	½″ minimum	
Masonry walls[3]	½″ minimum	½″ minimum
Monolithic concrete walls[3,4]	⅝″ maximum	⅞″ maximum
Monolithic concrete ceilings[3,4]	⅜″ maximum[5]	½″ maximum
Gypsum veneer base[6]	$^{1}/_{16}$″ minimum[1]	

For SI: 1 inch = 25.4 mm

1. When measured from back plane of expanded metal lath, exclusive of ribs, or self -furring lath, plaster thickness shall be ¾ inch minimum.
2. When measured from face of support or backing.
3. Because masonry and concrete surfaces may vary in plane, thickness of plaster need not be uniform.
4. When applied over a liquid bonding agent, finish coat may be applied directly to concrete surface.
5. Approved acoustical plaster may be applied directly to concrete or over base coat plaster, beyond the maximum plaster thickness shown.
6. Attachment shall be in accordance with Table 3607.2.3.4.

TABLE 3607.2.1b
GYPSUM PLASTER PROPORTIONS

NUMBER	COAT	PLASTER BASE OR LATH	MAXIMUM VOLUME AGGREGATE PER 100 POUNDS NEAT PLASTER[2] (cubic feet)	
			Damp Loose Sand[1]	Perlite or Vermiculite[3]
Two-coat work	Base coat	Gypsum lath	2½	2
	Base coat	Masonry	3	3
Three-coat work	First coat	Lath	2[4]	2
	Second coat	Lath	3[4]	2[5]
	First and second coats	Masonry	3	3

For SI: 1 inch = 25.4 mm, 1 cubic foot = 0.0283 m^3, 1 pound = 0.454 kg.

1. Wood-fibered gypsum plaster may be mixed in the proportions of 100 pounds of gypsum to not more than one cubic foot of sand where applied on masonry or concrete.
2. When determining the amount of aggregate in set plaster, a tolerance of 10% shall be allowed.
3. Combinations of sand and lightweight aggregate may be used, provided the volume and weight relationship of the combined aggregate to gypsum plaster is maintained.
4. If used for both first and second coats, the volume of aggregate may be 2½ cubic feet.
5. Where plaster is one inch or more in total thickness, the proportions for the second coat may be increased to three cubic feet.

TABLE 3607.2.1c
PORTLAND CEMENT PLASTER

MAXIMUM VOLUME AGGREGATE PER VOLUME CEMENTITIOUS MATERIAL[1]					MINIMUM PERIOD MOIST COATS	MINIMUM INTERVAL BETWEEN
COAT	Portland Cement Plaster[2] Maximum Volume Aggregate per Volume Cement	Portland Cement-lime Plaster[3]		Approximate Minimum Thickness[4] Curing		
		Maximum Volume Lime per Volume Cement	Maximum Volume Sand per Volume Cement and Lime			
First	4	¾	4	⅜[5]	48[6] Hours	48[7] Hours
Second	5	¾	5	First and Second coats	48 Hours	7 Days[8]
Finished	3[9]	-	3[9]	⅛	-	-[8]

For SI: 1 inch = 25.4 mm, 1 pound = 0.454 kg.

1. When determining the amount of aggregate in set plaster, a tolerance of 10% may be allowed.
2. From ten to 20 pounds of dry hydrated lime (or an equivalent amount of lime putty) may be added as a plasticizing agent to each sack of Type I and Type II standard portland cement in base coat plaster.
3. No additions of plasticizing agents shall be made.
4. See Table 3607.2.1a
5. Measured from face of support or backing to crest of scored plaster.
6. 24 hour minimum period for moist curing of interior portland cement plaster.
7. 24 hour minimum interval between coats of interior portland cement plaster.
8. Finish coat plaster may be applied to interior portland cement base coat after a 48-hour period.
9. For finish coat, plaster up to an equal part of dry hydrated lime by weight (or an equivalent volume of lime putty) may be added to Type I, Type II and Type III standard portland cement.

TABLE 3607.2.3.4
APPLICATION AND MINIMUM THICKNESS OF GYPSUM WALLBOARD

THICKNESS OF GYPSUM WALLBOARD (inch)	PLANE OF FRAMING SURFACE[4]	LONG DIMENSION OF GYPSUM WALLBOARD SHEETS IN RELATION TO DIRECTION OF FRAMING MEMBERS	MAXIMUM SPACING OF FRAMING MEMBERS (center-to-center in inches)	MAXIMUM SPACING OF FASTENERS (center-to-center, in inches)		NAILS[1] TO WOOD
				Nails[1,2]	Screws	
Fastening required without adhesive application.						
⅜	Horizontal[4]	Perpendicular	16	7	12	No. 13 gage 1¼" long, 19/64" head; 0.098" diameter, 1¼" long, annular-ringed; 4d cooler nail
	Vertical	Either direction	16	8	12	
½	Horizontal[3]	Either direction	16	7	12	No. 13 gage 1⅜" long, 19/64" head; 0.098"diameter, 1¼" long, annular-ringed; 5d cooler nail
	Horizontal[3]	Perpendicular	24	7	12	
	Vertical	Either direction	24	8	12	
⅝	Horizontal	Either direction	16	7	12	No. 13 gage 1⅝" long, 19/64" head; 0.098" diameter, 1⅜" long, annular-ringed; 6d cooler nail
	Horizontal	Perpendicular	24	7	12	
	Vertical	Either direction	24	8	12	
With adhesive application.						
⅜	Horizontal[4]	Perpendicular	16	16	16	Same as above for ⅜"
	Vertical	Either direction	16	16	24	
½ or ⅝	Horizontal	Either direction[3]	16	16	16	As required for ½" and ⅝" gypsum wallboard, see above
		Perpendicular	24	12	16	
	Vertical	Either direction	24	24	24	
2⅜ layers	Horizontal	Perpendicular	24	16	16	Base ply nailed as required for ½" gypsum wallboard and face ply placed with adhesive
	Vertical	Either direction	24	24	24	

For SI: 1 inch = 25.4 mm

1. Where the metal framing has a clinching design formed to receive the nails by two edges of metal, the nails shall not be less than ⅝ inch longer than the wallboard thickness and shall have ringed shanks. Where the metal framing has a nailing groove formed to receive the nails, the nails shall have barbed shanks or be 5d, 13½ gage, 1⅝ inches long, 15/64-inch head for ½-inch gypsum wallboard; 6d, 13 gage, 1⅞ inches long, 15/64 -inch head for ⅝-inch gypsum wallboard.
2. Two nails spaced not less than two inches apart, or more than 2½ inches apart may be used where the pairs are spaced 12 inches on center except around the perimeter of the boards.
3. ⅜-inch single-ply gypsum board shall not be installed if water-based textured finish is applied or to support insulation above a ceiling. On horizontal applications to receive a water-based texture material, either hand or spray applied, gypsum board shall be applied perpendicular to framing and board thickness increased from ⅜ inch to ½ inch for 16-inch o.c. framing, and from ½ inch to ⅝ inch for 24-inch o.c. framing.
4. Horizontal refers to applications such as ceilings. Vertical refers to applications such as walls.

3607.2.6.1 Attachment: Nails, staples or glue are permitted for use in attaching shakes or shingles to the wall, and the shakes or shingles shall be permitted to be attached directly to the surface provided the fasteners are appropriate for the type of wall surface material. When nails or staples are used, two fasteners shall be provided and shall be placed so that they are covered by the course above.

3607.2.6.2 Furring strips: Where furring strips are used, they shall be one inch by two inches or one inch by three inches (25 mm by 51 mm or 25 mm by 76 mm), spaced a distance on center equal to the shake or shingle exposure, and shall be attached to the wall by nailing through other wall material into the studs of the interior spaces.

3607.2.6.3 Bottom course: The bottom course shall be doubled.

780 CMR 3607.3 EXTERIOR COVERING

3607.3.1 General: All exterior walls shall be covered with approved materials designed and installed to provide a barrier against the weather and insects to enable environmental control of the interior spaces. The exterior coverings in 780 CMR 3607.0 shall be installed in the specified manner unless otherwise approved.

3607.3.2 Weather-resistant sheathing paper: Asphalt-saturated felt, free from holes and breaks and weighing not less than 14 pounds per 100 square feet (0.683 kg/m^2) or other approved weather-resistant material shall be applied over studs or sheathing of all exterior walls as required by Table ***3607.3.4***. Such felt or material shall be applied horizontally, with the upper layer lapped over the lower layer not less than two inches (51 mm). Where joints occur, felt shall be lapped not less than six inches (153 mm).

3607.3.2.1 Felt or material: Such felt or material may be omitted.

1. In detached accessory buildings.
2. Under panel siding with shiplap joints or battens.
3. Under exterior wall finish materials as permitted in Table ***3607.3.4***.
4. Under paperbacked stucco lath.
5. Over water-repellent sheathing materials.

3607.3.3 Wood, plywood and wood structural panel siding: Joints in wood, plywood or wood structural panel siding shall be made as follows unless otherwise approved. Vertical joints in panel siding shall occur over framing members, unless wood or wood structural panel sheathing is used, and shall be shiplapped or covered with a batten. Horizontal joints in panel siding shall be lapped a minimum of one inch (25 mm) or shall be flashed with Z-flashing.

3607.3.3.1 Horizontal siding: Horizontal siding shall be lapped a minimum of one inch (25 mm), or ½ inch (12.7 mm) if rabbeted, and shall have the ends caulked, covered with a batten, or sealed and installed over a strip of flashing.

3607.3.4 Attachments: Unless specified otherwise, all wall coverings shall be securely fastened in accordance with Table ***3607.3.4*** or with other approved aluminum, stainless steel, zinc-coated, or other approved corrosion-resistive fasteners.

3607.3.5 Wood shakes and shingles: Wood shakes and shingles shall conform to CSSB "Grading Rules for Wood Shakes and Shingles."

3607.3.5.1 Application: Wood shakes or shingles shall be applied either single-course or double-course over nominal ½-inch (12.7 mm) wood-based sheathing or to furring strips over ½-inch (12.7 mm) nominal non-wood sheathing. A weather-resistant permeable membrane shall be provided over the sheathing, with horizontal overlaps in the membrane of not less than two inches (51 mm) and vertical overlaps of not less than six inches (153 mm). Where furring strips are used, they shall be one inch by three inches or one inch by four inches (25 mm by 76 mm or 25 mm by 102 mm) and shall be fastened horizontally to the studs with 7d or 8d box nails and shall be spaced a distance on center equal to the actual weather exposure of the shakes or shingles, not to exceed the maximum exposure specified in Table ***3607.3.5.2***. The spacing between adjacent shingles to allow for expansion shall not exceed ¼ inch (6.4 mm), and between adjacent shakes, shall not exceed ½ inch (12.7 mm). The offset spacing between joints in adjacent courses a minimum of 1½ inches (38 mm).

3607.3.5.2 Weather exposure: The maximum weather exposure for shakes and shingles shall not exceed that specified in Table ***3607.3.5.2***.

3607.3.5.3 Attachment: Each shake or shingle shall be held in place by two hot-dipped zinc-coated, stainless steel, or aluminum nails or staples. The fasteners shall be long enough to penetrate the sheathing or furring strips by a minimum of ½ inch (12.7 mm) and shall not be overdriven.

3607.3.5.3.1 Staple attachment: Staples shall not be less than 16 gage and shall have a crown width of not less than $^7/_{16}$ inch (11 mm), and the crown of the staples shall be parallel with the butt of the shake or shingle. In single-course application, the fasteners shall be concealed by the course above and shall be driven approximately one inch (25 mm) above the butt line of the succeeding course and ¾ inch (19 mm) from the edge. In double-course applications, the exposed shake or shingle shall be face-nailed with two casing nails, driven approximately two inches (51 mm) above the butt line and ¾ inch (19 mm) from each edge. Staples shall not be permitted for face-nailing. With shingles wider than eight inches (203 mm), two additional nails shall be required and shall be nailed approximately one inch (25 mm) apart near the center of the shingle.

3607.3.6 Exterior lath: All lath and lath attachments shall be of corrosion-resistant materials.

Expanded metal or woven wire lath shall be attached with 1½ inch (38 mm) long, 11 gage nails having a $^7/_{16}$-inch (11 mm) head, or ⅞ inch (22 mm) long, 16 gage staples, spaced at no more than six inches (153 mm), or as otherwise approved.

3607.3.7 Masonry veneer, general: All masonry veneer shall be installed in accordance with 780 CMR 3607.3.7, Table ***3607.3.4*** and Figure ***3607.3.7***. Exterior masonry veneer shall not be laterally supported by wood frame at any point more than 35 feet (7620 mm) above the adjacent ground elevation.

Exceptions:

1. Veneers used as interior wall finishes may be supported on wood floors which are designed to support the loads imposed.
2. Exterior masonry veneers ***with*** an installed weight of 40 pounds per square foot (195 kg/m^2) or less may be supported on wood construction. When the masonry veneer is supported by wood construction that adjoins the masonry veneer supported by the foundation, there shall be a movement joint between the veneer supported by the wood construction and the foundation. The wood construction supporting the masonry veneer shall be designed to limit deflection to $^1/_{600}$ of the span for the supporting members.

3607.3.7.1 Lintels: Masonry veneer shall not support any vertical load other than the dead load of the veneer above. Veneer above openings shall be supported on lintels of noncombustible materials and the allowable span shall not exceed the values set forth in Table ***3607.3.7.1***. The lintels shall have a length of bearing of not less than four inches (102 mm).

3607.3.7.2 Attachment: Masonry veneer shall be attached to the supporting wall with corrosion-resistant metal ties.

3607.3.7.2.1 Size and spacing: Veneer ties, if strand wire, shall not be less in thickness than No. 9 U.S. gage wire and shall have a hood embedded in the mortar joint, or if sheet metal, not less than No. 22 U.S. gage by ⅞ inch (22 mm) corrugated. Each tie shall be spaced not more than 24 inches (610 mm) on center horizontally and shall support not more than 3¼ square feet (0.302 m^2) of wall area.

Exception: In wind areas of more than 30 pounds per square foot (1.44 kN/m^2), each tie shall support not more than two square feet (0.186 m^2) of wall area.

TABLE 3607.3.4
WEATHER-RESISTANT SIDING ATTACHMENT AND MINIMUM THICKNESS

SIDING MATERIAL		NOMINAL THICNESS[1] (inches)	JOINT TREATMENT	SHEATHING PAPER REQUIRED	TYPE OF SUPPORTS FOR THE SIDING MATERIAL AND FASTENERS[2,3,4]				
					Wood, or Wood structural Panel Sheathing	**Fiberboard Sheathing into Stud**	**Gypsum Sheathing into Stud**	**Direct to Studs**	**Number or Spacing of Fasteners**
Horizontal aluminum[5]	Without insulation	0.019[6]	Lap	No	0.120 nail 1½" long	0.120 nail 2" long	0.120 nail 2" long	Not allowed	Same as stud spacing
		0.024	Lap	No	0.120 nail 1½" long	0.120 nail 2" long	0.120 nail 2" long	Not allowed	
	With insulation	0.019	Lap	No	0.120 nail 1½" long	0.120 nail 2½" long	0.120 nail 2½" long	0120 nail 1½" long	
Brick veneer Concrete masonry veneer		2 2	780 CMR 3607.3	Yes (13)	See 780 CMR 3607.3 and Figure 3607.3.7[8]				
Hardboard[12] Board and batten-vertical		7/16	(7)	(7)	0.099 nail 2" long	0.099 nail 2½" long	0.099 nail 2" long	0.099 nail 1¾" long	6" panel edges 8" inter. sup.
Hardboard[12] Lap-siding-horizontal		7/16	(7)	(7)	0.099 nail 2" long	0.099 nail 2½" long	0.099 nail 2¼" long	0.099 nail 2" long	Same as stud spacing 2 per bearing
Steel[9]		29 ga.	Lap	No	0.113 nail 1¾" Staple 1¾"	0.113 nail 2¾" Staple 2½"	0.113 nail 2½" Staple 2¼"	Not allowed	Same as stud spacing
Stone veneer		2	780 CMR 3607.3	Yes	See 780 CMR 3607.3 and Figure 3607.3.7				
Particalboard panels		⅜ - ½	(7)	(7)	6d box nail	6d box nail	6d box nail	6d box nail, ⅜ not allowed	6" panel edges 12" inter. sup.
		⅝	(7)	(7)	6d box nail	8d box nail	8d box nail	6d box nail	
Plywood panel[10] (exterior grade)		⅜	(7)	(7)	0.099 nail 2" Staple 1⅜"	0.113 nail 2½" Staple 2¼"	0.099 nail 2" Staple 2"	0.099 nail 2" Staple 1⅜"	6" on edges 12" inter. sup.
Vinyl Siding[14]		0.035	Lap	No	0.120 nail 1½" Staple 1¾"	0.120 nail 2" Staple 2½"	0.120 nail 2" Staple 2½"	Not allowed	Same as stud spacing
Wood[11] Rustic drop Shiplap Bevel Butt tip		⅜ Minimum 19/32 Average 7/16 3/16	Lap Lap Lap	No No No	Fastener penetration into stud - 1"			0.113 nail 2½" Staple 2"	Face nailig up to 6" widths, 1 nail per bearing: 8" widrhs and over, 2 nails per bearing

For SI: 1 inch = 25.4 mm.

1. Based on stud spacing of 16 inches o.c. Where studs are spaces 24 inches, siding may be applied to sheathing approved for that spacing.
2. Nail is a general description and may be T-head, modified round head, or round head with smooth or deformed shanks.
3. Staples shall have a minimum crown width of 7/16-inch O.D. and be manufactured of minimum No. 16 gage wire.
4. Nails or staples must be aluminum, galvanized, or rust-preventive coated and shall be driven into the studs for fiberboard or gypsum backing.
5. Aluminum nails shall be used to attach aluminum siding.
6 Aluminum (0.019 inch) may be unbacked only when the maximum panel width is ten inches and the maximum flat area is eight inches. The tolerance for aluminum siding shall be ±0.002 inch of the nominal dimension.
7. If boards are applied over sheathing or weather resistant membrane, joints need not be treated. Otherwise, vertical joints must occur at studs and be covered with battens or be lapped.
8. All attachments shall be coated with a corrosion-resistive coating.
9. Shall be of approved type.
10. ⅜-inch plywood may be applied directly to studs spaced 16 inches on center. ½-inch plywood may be applied directly to studs spaced at 24 inches on center.
11. Woodboard sidings applied vertically shall be nailed to horizontal nailing strips or blocking set 24 inches o.c. Nails shall penetrate 1½ inches into studs, studs and wood sheathing combined, or blocking. A weather-resistant membrane shall be installed weatherboard fashion under the vertical siding unless the siding boards are lapped or battens are used.
12. Hardboard siding shall comply with AHA A135.6
13. For masonry veneer, a weather-resistant membrane or building paper is not required over water-repellent sheathing materials when a one-inch air space is provided between the veneer and the sheathing. When the one-inch space is

filled with mortar, a weather-resistant membrane or building paper is required over studs or sheathing.
14. Vinyl siding shall comply with ASTM D 3679.

TABLE 3607.3.5.2
MAXIMUM WEATHER EXPOSURE FOR WOOD SHAKES AND SHINGLES ON EXTERIOR WALLS
(Dimensions are in

LENGTH	EXPOSURE FOR SINGLE COURSE	EXPOSURE FOR DOUBLE COURSE
SHINGLES[1]		
16	7½	12[2]
18	8½	14[3]
24	11½	16
SHAKES[1]		
18	8½	14
24	11½	18

For SI: 1 inch = 25.4 mm
1. Dimensions given are for No. 1 Grade.
2. A maximum ten-inch exposure is permitted for No. 2 Grade.
3. A maximum 11-inch exposure is permitted for No. 2 Grade.

3607.3.7.2.2 Paper backing required: When applied over stud construction, the studs shall be spaced a maximum of 24 inches (610 mm) on center and approved paper shall first be applied over the sheathing or wires between the studs, except as otherwise provided in *780 CMR 3607.3.2* and mortar shall be slushed into the one-inch (25 mm) space between facing and paper.

Exception: As an alternate, an air space of at least one inch (25 mm) may be maintained between the backing and the veneer, in which case a weather-resistant membrane or felt sheathing paper or approved water-repellent sheathing shall be applied over the studs.

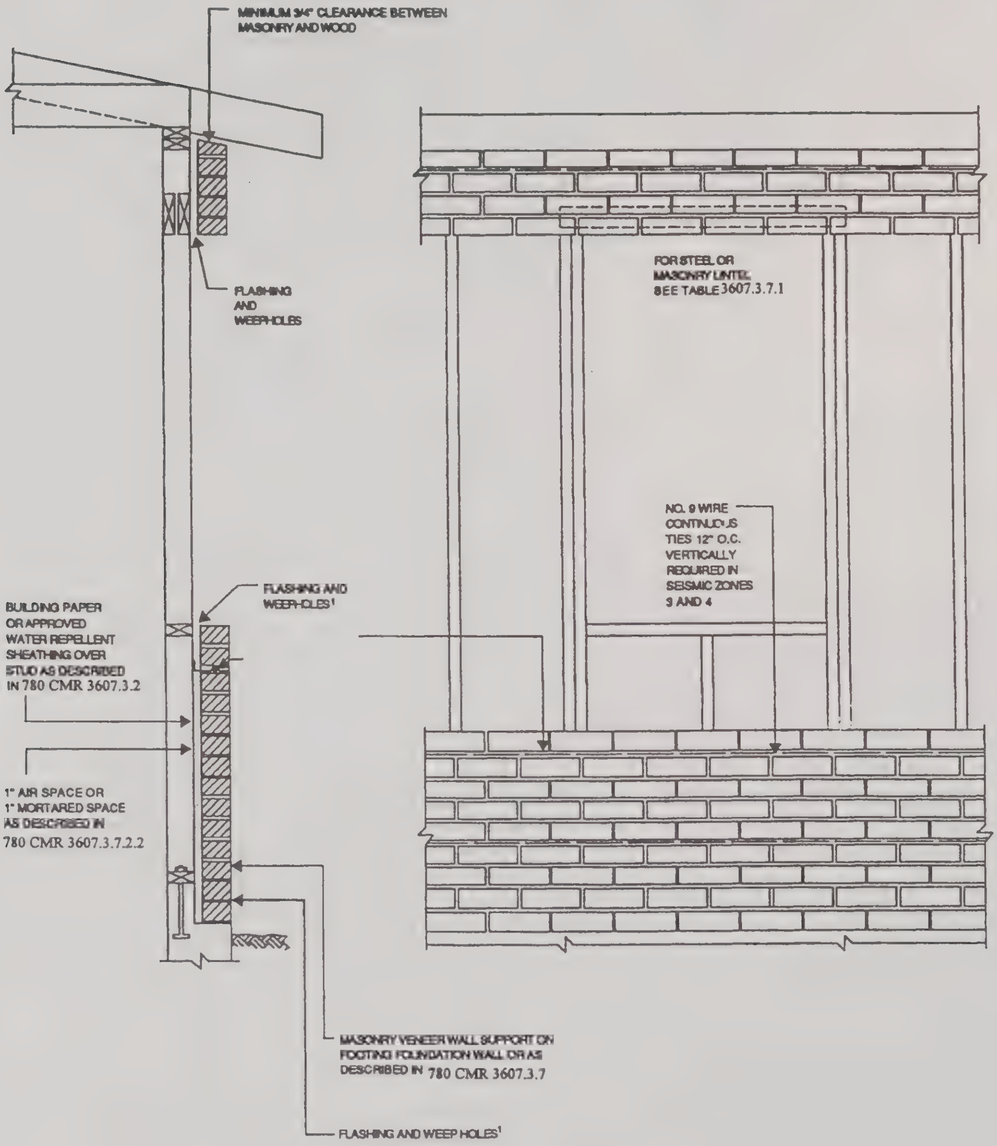
3607.3.7.2.3 Veneer grouting: In lieu of such wire ties, an approved method of grouting the veneer to a paperbacked reinforcement attached directly to the studs may be used.

3607.3.7.3 Flashing: Flashing shall be located beneath the first course of masonry above finished ground level above the foundation wall or slab, and at other points of support, including structural floors, shelf angles and lintels when masonry veneers are designed in accordance with *780 CMR 3607.3.7. See 780 CMR 3607.3.8* for additional requirements.

3607.3.7.4 Weepholes: Weepholes shall be provided in the outside of masonry walls at a maximum spacing of 33 inches (838 mm) on center. Weepholes shall not be less than $^{3}/_{16}$ inch (4.8 mm) in diameter. Weepholes shall be located immediately above the flashing.

3607.3.8 Flashing: Approved corrosion-resistive flashing shall be provided at top and sides of all exterior window and door openings in such a manner as to be leak-proof, except that self-flashing windows having a continuous lap of not less than 1⅜ inches (28 mm) over the sheathing material around the perimeter of the opening, including corners, do not require additional flashing; jamb flashing may also be omitted when specifically approved by the building official. Similar flashings shall be installed at the intersection of chimneys or other masonry construction with frame or stucco walls, with projecting lips on both sides under stucco copings; under and at the ends of masonry, wood or metal copings and sills; continuously above all projecting wood trim; where exterior porches. decks or stairs attach to a wall or floor assembly of wood-frame construction; at wall and roof intersections.

FIGURE 3607.3.7
MASONRY VENEERED WALL DETAIL


MINIMUM 3/4" CLEARANCE BETWEEN MASONRY AND WOOD
FLASHING AND WEEPHOLES
FOR STEEL OR MASONRY LINTEL SEE TABLE 3607.3.7.1
NO. 9 WIRE CONTINUOUS TIES 12" O.C. VERTICALLY REQUIRED IN SEISMIC ZONES 3 AND 4
FLASHING AND WEEPHOLES[1]
BUILDING PAPER OR APPROVED WATER REPELLENT SHEATHING OVER STUD AS DESCRIBED IN 780 CMR 3607.3.2
1" AIR SPACE OR 1" MORTARED SPACE AS DESCRIBED IN 780 CMR 3607.3.7.2.2
MASONRY VENEER WALL SUPPORT ON FOOTING FOUNDATION WALL OR AS DESCRIBED IN 780 CMR 3607.3.7
FLASHING AND WEEP HOLES[1]

For SI: 1 inch = 25.4 mm.

1. Location of flashing and weepholes as described in 780 CMR 3607.3.7.3 and 3607.3.7.4.

TABLE 3607.3.7.1
ALLOWABLE SPANS FOR LINTELS SUPPORTING MASONRY VENEER

SIZE OF STEEL ANGLE[1,3]	NO STORY ABOVE	ONE STORY ABOVE	TWO STORIES ABOVE	NO OF ½" OR EQUIVALENT REINFORCING BARS[2]
3 x 3 x ¼	6'-0"	3'-6"	3'-0"	1
4 x 3 x ¼	8' - 0"	5'-0"	3'-0"	1
6 x 3½ x ¼	14' - 0"	8'-0"	3'-6"	2
2-6 x 3½ x ¼	20' - 0"	11'-0"	5'-0"	4

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm.

1. Long leg of the angle shall be placed in a vertical position.
2. Depth of reinforced lintels shall not be less than eight inches and all cells of hollow masonry lintels shall be grouted and solid. Reinforcing bars shall extend not less than eight inches into the support.
3. Steel members indicated are adequate typical examples; other steel members meeting structural design requirements may be used.

ROOF-CEILING CONSTRUCTION

3608.1 GENERAL

3608.1.1 Application: The provisions of 780 CMR 3608.1 shall control the design and construction of the roof-ceiling system for all buildings. The use of materials or methods of construction not specified in 780 CMR 3608.1 accomplishing the purposes intended with 780 CMR 36 and approved by the building official in accordance with 780 CMR 36 and approved by the building official in accordance with ***780 CMR 109*** shall be accepted as complying with 780 CMR 36.

3608.1.2 Requirements: Roof-ceiling construction shall be capable of ***supporting*** all loads imposed according to ***780 CMR 3603.1*** and shall transmit the resulting loads to supporting structural elements.

3608.1.3 Roof drainage: In areas where expansive or collapsible soils are known to exist ***or where required by city or town ordinance or by-law***, all dwellings shall have a controlled method of water disposal from roofs that will collect and discharge all roof drainage to the ground surface at least five feet (1524 mm) from foundation walls or to an approved drainage system.

780 CMR 3608.2 ROOF FRAMING

3608.2.1 Identification and grade: Load-bearing dimension lumber for rafters, trusses and ceiling joists shall conform to DOC PS 20 and to other applicable standards or grading rules, ***as listed in Appendix A***, and be identified by a grade mark or certificate of inspection issued by an approved agency. The grade mark or certificate shall provide adequate information to determine F_b, the allowable stress in bending, and E, the modulus of elasticity. Approved end jointed lumber may be used interchangeably with solid-sawn members of the same species and grade. Blocking shall be a minimum of utility grade lumber.

> ***Exception:** Use of Native Lumber shall be allowed in accordance with 780 CMR 2303.0.*

> **3608.2.1.1 Fire-retardant-treated lumber**: The allowable unit stresses for fire-retardant-treated lumber, including fastener values, shall be developed from an approved method of investigation which considers the effects of anticipated temperature and humidity to which the fire-retardant lumber will be subjected, the type of treatment and redrying process. The fire-retardant treated lumber shall be graded by an approved agency.

3608.2.2 Design and construction: Roof-ceilings of wood construction shall be designed and constructed in accordance with the provisions of 780 CMR 3608.2 or with the AFPA NDS-1991 "National Design Specification for Wood Construction," the CWC-1987 "Canadian Dimension Lumber Data Book," the WWPA- 1992 "Western Lumber Span Tables for Floor and Ceiling Joists and Roof Rafters," or the "Southern Pine Maximum Spans for Joists and Rafters," ***each as listed in Appendix A***. Roof-ceilings shall be constructed in accordance with Figures ***3606.4.10a***, ***3606.4.10b***, ***3606.4.10c*** and ***3608.2.4.1*** and nailed in accordance with Table ***3606.2.3a***.

> **3608.2.2.1 Cathedral ceilings**: When ceiling joists and rafter ties are omitted and the rafters are used to create a cathedral ceiling, rafter ends shall be supported on bearing walls, headers or ridge beams. Rafters shall be attached to supporting members in accordance with Table ***3606.2.3a***. Ridge beams shall be capable of carrying the imposed roof loads and shall be supported by structural elements which transmit the loads to the foundation.

3608.2.3 Framing details: Rafters shall be nailed to ceiling joists to form a continuous tie between exterior walls where joists are parallel to the rafters. Where not parallel, rafters shall be tied with a rafter tie, located as near the plate as practical. Rafter ties shall be spaced not more than four feet (1219 mm) on center. Rafters shall be framed to ridge board or to each other with gusset plate as a tie. Ridge board shall be at least one-inch (25 mm) nominal thickness and not less in depth than the cut end of the rafter. At all valleys and hips there shall be a valley or hip rafter not less than two-inch (51 mm) nominal thickness and not less in depth than the cut end of the rafter. Hip and valley rafters shall be supported at the ridge by a brace to a bearing partition or be designed to carry and distribute the specific load at that point.

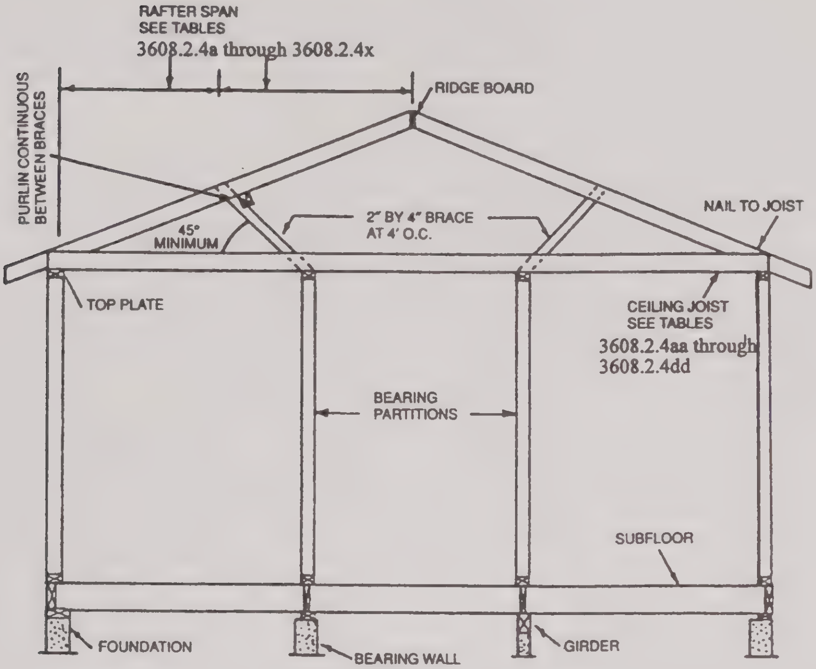
> **3608.2.3.1 Ceiling joists lapped**: Ends of ceiling joists shall be lapped a minimum of three inches (76 mm) or butted over bearing partitions or beam and toenailed to the bearing member. When ceiling joists are used to provide resistance to rafter thrust, lapped joists shall be nailed together and butted joists shall be tied together in a manner to resist such thrust.

3608.2.3.2 Collar ties: Pairs of rafters on opposing sides of a ridge board in roof pitches over three units vertical in 12 units horizontal shall be connected by collar ties. Collar ties shall be located at a maximum spacing of 48 inches on center, measured parallel to the ridge, or at every third pair of rafters, whichever is smaller. Collar ties shall be located in the upper third of the height of the roof, measured from the sill plate to the ridge, and shall be a minimum of one inch by six inch dimension lumber. Collar ties shall be connected to rafters in accordance with the requirements for rafter ties in Table 3606.2.3a.

3608.2.4 Allowable spans: The unsupported spans for ceiling joists shall not exceed the values set forth in Tables ***3608.2.4aa*** through ***3608.2.4dd*** The unsupported spans for rafters shall not exceed the values set forth in Tables ***3608.2.4a through 3608.2.4x***. When the roof pitch is less than three units vertical in 12 units horizontal (25% slope), members supporting rafters and ceiling joists, such as ridge beams, hips and valleys, shall be designed as beams. Selection of rafters shall be based on lumber properties, snow load zone and deflection due to live load based on ceiling finish (see table 3603.1.6

3608.2.4.1 Purlins: Purlins may be installed to reduce the span of rafters as shown in Figure ***3608.2.4.1***. Purlins shall be sized no less than the required size of the rafters that they support. Purlins shall be continuous and shall be supported by two by four (51 by 102) struts installed to bearing walls at a slope not less than 45 degrees from the horizontal. The struts shall be spaced not more than four feet (1219 mm) on center, and the unbraced length of struts shall not exceed eight feet (2438 mm).

FIGURE 3608.2.4.1
BRACED RAFTER CONSTRUCTION


RAFTER SPAN
SEE TABLES
3608.2.4a through 3608.2.4x
RIDGE BOARD
PURLIN CONTINUOUS
BETWEEN BRACES
45°
MINIMUM
2" BY 4" BRACE
AT 4' O.C.
NAIL TO JOIST
TOP PLATE
CEILING JOIST
SEE TABLES
3608.2.4aa through
3608.2.4dd
BEARING
PARTITIONS
SUBFLOOR
FOUNDATION
BEARING WALL
GIRDER

For SI: one inch = 25.4 mm, one foot = 304.8 mm.
NOTE: Where ceiling joists run perpendicular to the rafters, rafter ties shall be nailed to the rafters near the plate line and spaced not more than four feet on center.

3608.2.5 Bearing: The ends of each rafter or ceiling joist shall have not less than 1½ inches (38 mm) of bearing on wood or metal and not less than three inches (76 mm) on masonry.

3608.2.6 Cutting and notching: It shall be unlawful to notch, cut or pierce wood beams, joists or rafters in excess of the limitations herein specified, unless proven safe by structural analysis or suitably reinforced to transmit all calculated *loads*. Notches in the top or bottom of rafter shall not exceed $^{1}/_{16}$ of the depth of the rafter, ***shall not be longer than ⅓ the depth of the member*** and shall not be located in the middle third of the span. ***Notch depth at the ends of the member*** shall not exceed ¼ the rafter depth.

Exceptions:

1. A notch over the support is permitted to extend the full width of the support.

2. Notches on cantilevered portions of the member are permitted to extend the full length of the cantilever if the strength and deflection of the cantilever is calculated based on the reduced member section.

3. The tension side of rafters which are four inches or greater in nominal thickness, shall not be notched, except at ends of members.

3608.2.7 Holes: Holes drilled, bored ***or cut*** into rafters shall ***not be closer than*** two inches (51 mm) to the top or bottom of the rafters, ***or to any other hole located in the rafter. Where the rafter is notched, the hole shall not be closer than two***

NON-TEXT PAGE

inches to the notch. The diameter ***of the hole*** shall not exceed ⅓ the depth of the rafter.

3608.2.8 Lateral support: Rafters and ceiling joists having a depth-to-thickness ratio exceeding five to one based on nominal dimensions shall be provided with lateral support at points of bearing to prevent rotation.

3608.2.8.1 Bridging: Rafters and ceiling joists having a depth-to-thickness ratio exceeding six to one based on nominal dimensions shall be supported laterally by solid blocking, diagonal bridging (wood or metal) or a continuous one-inch-by-three-inch (25 mm by 76 mm) wood strip nailed across the rafters or ceiling joists at intervals not exceeding ten feet (3048 mm).

3608.2.9 Framing of openings: Openings in roof and ceiling framing shall be framed with headers between ceiling joists or rafters. When the header span does not exceed four feet (1219 mm), the header may be a single member the same size as the ceiling joist or rafter. When the header span exceeds four feet (1219 mm), the header and the joists or rafters that support the header shall be doubled, and approved hangers shall be used to connect the header to the joists or rafters.

3608.2.10 Trusses: Wood trusses shall be designed in accordance with approved engineering practice. Truss components may be joined by nails, glue, timber connectors or other approved fastening devices. The design of metal plate connected wood trusses shall comply with TPI QST, TPI PCT and TPI-1985 "Design Specification for Metal Plate Connected Wood Trusses", ***each as listed in Appendix A***. Trusses shall be braced according to their appropriate engineered design. In the absence of specific bracing requirements, trusses shall be braced in accordance with TPI BWT, ***as listed in Appendix A***. Truss members shall not be cut or altered unless so designed.

3608.2.11 Roof tie-down: Roof assemblies subject to wind uplift pressures of 20 pounds per square foot (0.958 kN/m^2) or greater, shall have rafter or truss ties provided in accordance with Table ***3608.2.12***. The resulting uplift forces from the rafter or truss ties shall be transmitted to the foundation.

780 CMR 3608.3 ROOF SHEATHING

3608.3.1 Lumber sheathing: Allowable spans for lumber used as roof sheathing shall conform to Table ***3608.3.1***. Spaced lumber sheathing for wood shingle and shake roofing shall conform to the requirements of ***780 CMR 3609.8 and 3609.9***.

3608.3.2 Plywood sheathing:

3608.3.2.1 Identification and grade: Plywood and wood structural panels shall conform to DOC PS 1 or DOC PS 2 ***as listed in Appendix A***, and shall be identified by grade mark or certificate of inspection issued by an approved agency. Plywood and wood structural panels shall comply with the grades specified in Table ***3605.3.2.1.1a***.

3608.3.2.1.1 Type: All plywood, when designed to be exposed in outdoor applications, shall be of an exterior type. Plywood or wood structural panel roof sheathing exposed to the underside may be of interior type bonded with exterior glue, identified as Exposure 1.

3608.3.2.1.2 Fire-retardant-treated plywood: The allowable unit stresses for fire-retardant-treated plywood, including fastener values, shall be developed from an approved method of investigation which considers the effects of anticipated temperature and humidity to which the fire-retardant plywood will be subjected, the type of treatment and redrying process. The fire-retardant-treated plywood shall be graded by an approved agency.

3608.3.2.1.3 Wood structural panels: Wood structural-use panels conforming to DOC PS 2, ***as listed in Appendix A***, includes performance-rated plywood, oriented strandboard and composite panels. Oriented strandboard structural-use panels manufactured in Canada shall conform to CSA 0437 ***as listed in Appendix A***.

3608.3.2.2 Allowable spans: The maximum allowable spans for plywood and wood structural panel roof sheathing shall not exceed the values set forth in Table ***3605.3.2.1.1a***.

3608.3.2.3 Installation: Plywood and wood structural panel roof sheathing shall be installed with joints staggered or nonstaggered in accordance with Tables **3605.3.2.1.1a** and **3606.2.3a**, or APA E 30 ***as listed in Appendix A***.

TABLE 3608.2.12
WIND UPLIFT FORCES ON ROOF TRUSSES AND RAFTERS[1,2,3,4]
(Pounds Per Tie-Down Connection)

WIND UPLIFT PRESSURE ON ROOF (psf)[5]	TOTAL BUILDING WIDTH ROOF INCLUDING OVERHANG (feet)				
	24	28	32	36	40
20	192	224	256	288	320
30	432	504	576	648	720
40	672	784	895	1,008	1,120
50	912	1,064	1,216	1,368	1,520
60	1,152	1,344	1,536	1,728	1,920
70	1,392	1,624	1,856	2,088	2,320
80	1,632	1,904	2,176	2,448	2,720
90	1,872	2,184	2,496	2,808	3,120

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, psf = 0.0479 kNm^2

1. A continuous load path capable of resisting the tributary forces shall be provided from tie-down connections to the foundation.
2. Wind uplift forces are based on 24-inch spacing of roof trusses or rafters. For spacing other than 24 inches, forces shall be adjusted accordingly.
3. Interpolation is permitted for intermediate values of wind uplift pressures and building widths.
4. The rated capacity of approved tie-down devices is permitted to include a ⅓ increase for wind effects.
5. Tie-down connections shall be provided at bearing walls for roof trusses or rafters to resist wind uplift forces.

3608.3.3 Particleboard sheathing:

3608.3.3.1 Identification and grade: Particleboard roof sheathing shall conform to Type 2-M-W as set forth in ANSI A208.1 *as listed in Appendix A* and shall be so identified by a grade mark or certificate of inspection issued by an approved agency.

3608.3.3.2 Allowable spans: The allowable loads and spans for particleboard roof sheathing shall not exceed the values set forth in Table 3608.3.3.2.

3608.3.3.3 Installation: Particleboard roof sheathing shall be installed in accordance with Tables *3606.2.3a* and *3608.3.3.2*. Where walls are subject to wind pressures of 30 pounds per square foot (1.44 kN/m^2) or greater, particleboard roof sheathing shall be attached to the gable end with 8d common nails spaced at no more than four inches *on center* (102 mm), or equivalent fasteners.

TABLE 3608.3.1
MINIMUM THICKNESS LUMBER ROOF SHEATHING

RAFTER OR BEAM SPACING (inches)	MINIMUM NET THICKNESS (inches)
24	⅝
48[1]	1½ T & G
60[2]	
72[3]	

For SI: 1 inch = 25.4 mm, 1 psi= 6.895 kPa.

1. Minimum 270 F_b, 340,000 *E*.
2. Minimum 420 F_b, 660,000 *E*.
3. Minimum 600 F_b, 1,150,000 *E*.

TABLE 3803.3.2
ALLOWABLE LOADS FOR PARTICLEBOARD ROOF SHEATHING[1,2,3]

GRADE	THICKNESS (inches)	MAXIMUM ON-CENTER SPACING	LIVE LOAD (pounds per square foot)	TOTAL LOAD (pounds per square foot)
2-M-W	⅜[4]	16	45	65
	7/16[4]	16	105	105
	7/16[4]	24	30	40
	½	16	110	150
	½	24	40	55

For SI: 1 inch = 25.4 mm, 1 psi = 6895 kPa.

1. Panels are continuous over two or more spans.
2. Uniform load deflection limitations: 1/180 of the span under live load plus dead load and 1/240 of the span under live load only.
3. The panels may be applied parallel or perpendicular to the span of the rafters or joists and shall be continuous over two or more spans. If the panels are applied perpendicular to roof supports, the end joints of the panels shall be offset so that four panel corners will not meet. Cutouts for items such as plumbing and electrical shall be oversized to avoid a forced fit. A ½-inch gap must be provided between the panel and concrete masonry walls. Leave a 1/16-inch gap between panels and nail no closer than ⅜ inch from panel edge.
4. Edges shall be tongue and groove or supported with blocking or edge clips.

780 CMR 3608.4 METAL

3608.4.1 General: Elements shall be straight and free of any defects which would significantly affect their structural performance.

3608.4.2 Steel Elements: Steel structural elements in roof-ceiling construction may be either hot-rolled structural steel shapes or members cold formed to shape from steel strip or plate or a fabricated combination thereof. Steel structural members in roof-ceiling construction shall be designed in accordance with the AISC "Specification for the Design", "Fabrication and Erection of Structural Steel for Buildings" as listed in Appendix A.

3608.4.3 Aluminum Elements: Aluminum structural elements in roof-ceiling systems shall, be constructed of materials and designed in accordance with AA SAS 30 as listed in Appendix A.

780 CMR 3608.5 CEILING FINISHES

3608.5.1 Ceiling installation: Ceilings shall be installed in accordance with the requirements for interior wall finishes, as provided in *780 CMR 3607.2*.

780 CMR 3608.6 ROOF VENTILATION

3608.6.1 Ventilation required: Enclosed attics and enclosed rafter spaces formed where ceilings are applied directly to the underside of roof rafters shall have cross ventilation for each separate space by ventilating openings protected against the entrance of rain or snow. Ventilating openings shall be provided with corrosion-resistant wire mesh, with the least dimension being ⅛ inch (3.2 mm).

3608.6.2 Minimum area: The total net free ventilating area shall not be less than one to 150 of the area of the space ventilated except that the total area is permitted to be reduced to one to 300, provided at least 50% and not more than 80% of the required ventilating area is provided by ventilators located in the upper portion of the space to be ventilated at least three feet (914 mm) above eave or cornice vents with the balance of the required ventilation provided by eave or cornice vents. As an alternative, the net free cross-ventilation area may be reduced to one to 300 when a vapor barrier having a transmission rate not exceeding one perm (57.4 $ng/s{\cdot}m^2{\cdot}Pa$) is installed on the warm side of the ceiling.

3608.6.3 Vent clearance: Where eave or cornice vents are installed, insulation shall not block the free flow of air. A minimum of one-inch (25 mm) space shall be provided between the insulation and the roof sheathing at the location of the vent.

780 CMR 3608.7 ATTIC ACCESS

3608.7.1 Accessible attic access: A readily accessible attic access framed opening not less than 22 inches by 30 inches (559 mm by 762 mm) shall be provided to any attic area having a clear height of over 30 inches (762 mm).

TABLE 3608.2.4aa
ALLOWABLE SPANS FOR CEILING JOISTS
20 Lbs. per Sq. Ft. Live Load

(Limited attic storage where development of future rooms is not possible)

(Veneer Plaster Ceiling)

DESIGN CRITERIA: Deflection—For 20 lbs. per sq. ft. live load. Limited to span in inches divided by 360. Strength—Live load of 20 lbs. per sq. ft. plus dead load of 10 lbs. per sq. ft. determines fiber stress value shown.

HOW TO USE TABLES: Enter table with span of joists (upper figure in each square). Determine size and spacing (first column) based stress grade (lower figure in each square) and modulus of elasticity (top row) of lumber to be used.

JOIST SIZE AND SPACING		MODULUS OF ELASTICITY, "*E*," IN 1,000,000 PSi									
(inches)	**(inches)**	**0.4**	**0.5**	**0.6**	**0.7**	**0.8**	**0.9**	**1.0**	**1.1**	**1.2**	**1.3**
2 x 4	12.0	5-5 430	5-10 500	6-2 560	6-6 630	6-10 680	7-1 740	7-4 790	7-7 850	7-10 900	8-0 950
	16.0	4-11 470	5-4 550	5-8 620	5-11 690	6-2 750	6-5 810	6-0 870	6-11 930	7-1 990	7-3 1,040
	24.0	4-4 540	4-8 630	4-11 710	5-2 790	5-5 860	5-8 930	5-10 1,000	6-0 1,070	6-2 1,130	6-4 1,190
2 x 6	12 0	8-6 430	9-2 500	9 9 560	10-3 630	10-9 680	11-2 740	11-7 790	11-11 850	12-3 900	12-7 950
	16.0	7-9 470	8-4 550	8-10 620	9-4 690	9 9 750	10-2 810	10-6 870	10-10 930	11-2 990	11-5 1,040
	24 0	6-9 540	7-3 630	7-9 710	8-2 790	8-6 860	8-10 930	9-2 1,000	9-6 1,070	9-9 1,130	10-0 1.190
2 x 8	12 0	11-3 430	12-1 500	12-10 560	13-6 630	14-2 680	14-8 740	15-3 790	15-9 850	16-2 900	16-7 950
	16.0	10-2 470	11-0 550	11-8 620	12-3 690	12-10 750	13-4 810	13-10 870	14-3 930	14-8 990	15-1 1,040
	24.0	8-11 540	9-7 630	10-2 710	10-9 790	11-3 860	11-8 930	12-1 1,000	12-6 1,070	12-10 1,130	13-2 1,190
2x 10	12.0	14-4 430	15-5 500	16-5 560	17-3 630	18-0 680	18-9 740	19-5 790	20- 1 850	20-8 900	21 -2 950
	16.0	13-0 470	14-0 550	14-11 620	15-8 690	16-5 750	17-0 810	17-8 870	18-3 930	18-9 990	19-3 1,040
	24.0	11-4 540	12-3 630	13-0 710	13-8 790	14-4 860	14-11 930	15-5 1,000	15-11 1,070	16-5 1,130	16-10 1,190
(inches)	**(inches)**	**1.4**	**1.5**	**1.6**	**1.7**	**1.8**	**1.9**	**2.0**	**2.2**	**2.4**	
2 x 4	12.0	8-3 990	8-5 1,040	8-7 1,090	8-9 1,130	8-11 1,170	9-1 1,220	9-3 1,260	9-7 1,340	9-10 1,420	
	16.0	7-6 1,090	7-8 1,140	7-10 1,200	8-0 1,240	8-1 1,290	8-3 1,340	8-5 1,390	8-8 1,480	8-11 1,570	
	24.0	6-6 1,250	6-8 1,310	6-10 1,370	7-0 1,420	7-1 1,480	7-3 1,530	7-4 1,590	7-7 1 690	7-10 1,790	
2 x 6	12.0	12-11 990	13-3 1,040	13-6 1,090	13-9 1,130	14-1 1,170	14-4 1,220	14-7 1,260	15 0 1 340	15-6 1,420	
	16.0	11-9 1,090	12-0 1,140	12-3 1,200	12-6 1,240	12-9 1,290	13-0 1,340	13-3 1,390	13-8 1,480	14-1 1,570	
	24.0	10-3 1,250	10-6 1,310	10-9 1,370	10-11 1,420	11-2 1,480	11-4 1,530	11-7 1,590	11.11 1,690	12-3 1,790	
2 x 8	12.0	17-0 990	17-5 1,040	17-10 1,090	18-2 1,130	18-6 1,170	18-10 1,220	19-2 1,260	19-10 1,340	20-5 1,420	
	16.0	15-6 1,090	15-10 1,140	16-2 1,200	16-6 1,240	16-10 1,290	17-2 1,340	17-5 1,390	18-0 1,480	18-6 1,570	
	24.0	13-6 1,250	13-10 1,310	14-2 1,370	14-5 1,420	14-8 1,480	15-0 1,530	15-3 1,590	15-9 1,690	16-2 1,790	
2 x 10	12.0	21-9 990	22-3 1,040	22-9 1,090	23-2 1,130	23-8 1,170	24-1 1,220	24-6 1,260	25-3 1,340	26-0 1,420	
	16.0	19-9 1,090	20-2 1,140	20-8 1,200	21-1 1,240	21-6 1,290	21-10 1,340	22-3 1,390	22-11 1,480	23-8 1,570	
	24.0	17-3 1,250	17-8 1,310	18-0 1,370	18-5 1,420	18-9 1,480	19-1 1,530	19-5 1,590	20-1 1,690	20-8 1,790	

For SI: I inch = 25.4 mm. 1 pound per square inch = 6.895 kPa,1I pound per square foot = 0.0479 kN/m2.

NOTE: The extreme fiber stress in bending, *"Fb,"* in pounds per square inch is shown below each span.

TABLE 3608.2.4bb
ALLOWABLE SPANS FOR CEILING JOISTS
20 Lbs. per Sq. Ft. Live Load
(Limited attic storage where development of future rooms is not possible)
(Gypsum Ceiling)

DESIGN CRITERIA: Deflection—For 20 Ibs. per sq. ft. live load. Limited to span in inches divided by 240. Strength—Live load of 20 Ibs. per sq. ft. plus dead load of 10 Ibs. per sq. ft. determines fiber stress value.

HOW TO USE TABLES: Enter table with span of joists (upper figure in each square). Determine size and spacing (first column) based stress grade (lower figure in each square) and modulus of elasticity (top row) of lumber to be used.

JOIST SIZE AND SPACING		MODULUS OF ELASTICITY, "*E*," IN 1,000,000 PSI									
(inches)	**(inches)**	**0.4**	**0.5**	**0.6**	**0.7**	**0.8**	**0.9**	**1.0**	**1.1**	**1.2**	**1 .3**
2 x 4	12.0	6-2 560	6-8 660	7-1 740	7-6 820	7-10 900	8-1 970	8-5 1,040	8-8 1,110	8-11 1,170	9-2 1,240
	16.0	5-8 620	6-1 720	6-5 810	6-9 900	7-1 990	7-5 1,070	7-8 1,140	7-11 1,220	8-1 1,290	8-4 1,360
	24.0	4-11 710	5-4 830	5-8 930	5-11 1,030	6-2 1,130	6-5 1,220	6-8 1,310	6-11 1,400	7-1 1,480	7-3 1,560
2 x 6	12.0	9-9 560	10-6 660	11-2 740	11-9 820	12-3 900	12-9 970	13-3 1,040	13-8 1,110	14-1 1,170	14-5 1,240
	16.0	8-10 620	9-6 720	10-2 810	10-8 900	11-2 990	11-7 1,070	12-0 1,140	12-5 1,220	12-9 1,290	13-1 1,360
	24.0	7-9 710	8-4 830	8-10 930	9-4 1,030	9-9 1,130	10-2 1,220	10-6 1,310	10-10 1,400	11-2 1,480	11 -5 1,560
2 x 8	12.0	12-10 560	13-10 660	14-8 740	15-6 820	16-2 900	16-10 970	17-5 1,040	18-0 1,110	18-6 1,170	19-0 1,240
	16.0	11 -8 620	12-7 720	13-4 810	14-1 900	14-8 990	15-3 1,070	15-10 1,140	164 1,220	16-10 1,290	17-3 1,360
	24.0	10-2 710	11-0 830	11-8 930	12-3 1,030	12-10 1,130	13-4 1,220	13-10 1,310	14-3 1,400	14-8 1,480	15-1 1,560
2 x 10	12.0	16-5 560	17-8 660	18-9 740	19-9 820	20-8 900	21 -6 970	22-3 1,040	22-11 1,110	23-8 1,170	24-3 1,240
	16.0	14-11 620	16-0 720	17-0 810	17-11 900	18-9 990	19-6 1,070	20-2 1,140	20-10 1,220	21-6 1,290	22-1 1,360
	24.0	13-0 710	14-0 830	14-11 930	15-8 1,030	16-5 1,130	17-0 1,220	17-8 1,310	18-3 1,400	18 9 1,480	19-3 1,560
(inches)	**(inches)**	**1.4**	**1.5**	**1.6**	**1.7**	**1.8**	**1.9**	**2.0**	**2.2**	**2.4**	
2 x 4	12.0	9-5 1,300	9-8 1,360	9-10 1,420	10-0 1,480	10-3 1,540	10-5 1,600	10-7 1,650	10-11 1,760	11-3 1,860	
	16.0	8-7 1,430	8-9 1,500	8- 11 1,570	9- 1 1,630	9-4 1,690	9-6 1,760	9-8 1,820	9- 11 1,940	10-3 2,050	
	24.0	7-6 1,640	7-8 1,720	7-10 1,790	8-0 1,870	8-1 1,940	8-3 2,010	8-5 2,080	8-8 2,220	8-11 2,350	
2 x 6	12.0	14-9 1,300	15-2 1,360	15-6 1,420	15-9 1,480	16-1 1,540	16-4 1,600	16-8 1,650	17-2 1,760	17-8 1,860	
	16.0	13-5 1,430	13-9 1,500	14-1 1,570	14-4 1,630	14-7 1,690	14-11 1,760	15-2 1,820	15-7 1,940	16-1 2,050	
	24.0	11-9 1,640	12-0 1,720	12-3 1,790	12-6 1,870	12-9 1,940	13-0 2,010	13-3 2,080	13-8 2,220	14-1 2,350	
2 x 8	12.0	19-6 1,300	19-11 1,360	20-5 1,420	20-10 1,480	21-2 1,540	21-7 1,600	21-11 1,650	22-8 1,760	23-4 1,860	
	16.0	17-9 1,430	18-2 1,500	18-6 1,570	18-11 1,630	19-3 1,690	19-7 1,760	19-11 1,820	20-7 1,940	21-2 2,050	
	24.0	15-6 1,640	15-10 1,720	16-2 1,790	16-6 1,870	16-10 1,940	17-2 2,010	17-5 2,080	18-0 2,220	18-6 2,350	
2 x 10	12.0	24-10 1,300	25-5 1,360	26-0 1,420	26-6 1,480	27-1 1,540	27-6 1,600	28-0 1,650	28-11 1,760	29-9 1,860	
	16.0	22-7 1,430	23-2 1,500	23-8 1,570	24- 1 1,630	24-7 1,690	25-0 1,760	25-5 1,820	26-3 1,940	27- 1 2,050	
	24.0	19-9 1,640	20-2 1,720	20-8 1,790	21-1 1,870	21-6 1,940	21-10 2,010	22-3 2,080	22-11 2,220	23-8 2,350	

For SI: I inch = 25.4 mm, I pound per square inch = 6.895 kPa, I pound per square foot = 0.0479 kN/m2.

NOTE: The extreme fiber stress in bending, *"Fb,"*in pounds per square inch is shown below each span.

TABLE 3608.2.4cc
ALLOWABLE SPANS FOR CEILING JOISTS
10 Lbs. per Sq. Ft. Live Load
(No attic storage and roof slope not steeper than 3 in 1 2)
(Veneer Plaster Ceiling)

DESIGN CRITERIA: Deflection-For 10 lbs. per sq. Ft. live load. Limited to span in inches divided by 360. Strength-Live load of 10 lbs. per sq. Ft. plus dead load of 5 lbs. per sq. ft. determines fiber stress value.
HOW TO USE TABLES: Enter table with span of joists (upper figure in each square). Determine size and spacing (first column) based stress grade (lower figure in each square) and modulus of elasticity (top row) of lumber to be used.

JOIST SIZE AND SPACING		MODULUS OF ELASTICITY, "E" IN 1,000,000 PSI									
(inches}	(inches)	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.1	1.2	1.3
2 x 4	12.0	6-10 340	7-4 400	7-10 450	8-3 500	8-7 540	8-11 590	9-3 630	9-7 670	9-10 710	10-1 750
	16.0	6-2 380	6-8 440	7-1 490	7-6 550	7-10 600	8-1 650	8-5 690	8-8 740	8-11 780	9-2 830
	24.0	5-5 430	5-10 500	6-2 560	6-6 630	6-10 680	7-1 740	7-4 790	7-7 850	7-10 900	8-0 950
2 x 6	12.0	10-9 340	11-7 400	12-3 450	12-11 500	13-6 540	14-1 590	14-7 630	15-0 670	15-6 710	15-11 750
	16.0	9-9 380	10-6 440	11-2 490	11-9 550	12-3 600	12-9 650	13-3 690	13-8 740	14.1 780	14-5 830
	24.0	8-6 430	9-2 500	9-9 560	10-3 630	10-9 680	11-2 740	11-7 790	11-11 850	12-3 900	12-7 950
2 x 8	12.0	14-2 340	15-3 400	16-2 450	17-0 500	17-10 540	18-6 590	19-2 630	19-10 670	20-5 710	20-11 750
	16.0	12-10 380	13-10 440	14-8 490	15-6 550	16-2 600	16-10 650	17-5 690	18-0 740	18-6 780	19-0 830
	24.0	11-3 430	12-1 500	12-10 560	13-6 630	14-2 680	14-8 740	15-3 790	15-9 850	16-2 900	16-7 950
2 x 10	12.0	18-0 340	19-5 400	20-8 450	21-9 500	22-9 540	23-8 590	24-6 630	25-3 670	26-0 710	26-9 750
	16.0	16-5 380	17-8 440	18-9 490	19-9 550	20-8 600	21 -6 650	22-3 690	22- 11 740	23-8 780	24-3 830
	24.0	14-4 430	15-5 500	16-5 560	17-3 630	18-0 680	18-9 740	19-5 790	20-1 850	20-8 900	21-2 950
(inches)	(inches)	1.4	1.5	1.6	1.7	1.8	1.9	2.0	2.2	2.4	
2 x 4	12.0	10-4 790	10-7 830	10-10 860	11-1 900	11-3 930	11-6 970	11-8 1,000	12-1 1,070	12-5 1,130	
	16.0	9-5 870	9-8 910	9-10 950	10-0 990	10-3 1,030	10-5 1,060	10-7 1,100	10 11 1,170	11-3 1,240	
	24.0	8-3 990	8-5 1,040	8-7 1,090	8-9 1,130	8-11 1,170	9-1 1,220	9-3 1,260	9-7 1,340	9-10 1,420	
2 x 6	12.0	16-3 790	16-8 830	17-0 860	17-4 900	17-8 930	18-0 970	18-4 1,000	18-11 1,070	19-6 1,130	
	16.0	14-9 870	15-2 910	15-6 950	15-9 990	16-1 1,030	16-4 1,060	16-8 1,100	17-2 1,170	17-8 1,240	
	24.0	12-11 990	13-3 1,040	13-6 1,090	13-9 1,130	14-1 1,170	14-4 1,220	14-7 1,260	15-0 1,340	15-6 1,420	
2 x 8	12.0	21 -5 790	21 - 11 830	22-5 860	22- 11 900	23-4 930	23-9 970	24-2 1,000	24- 11 1,070	25-8 1,130	
	16.0	19-6 870	19-11 910	20-5 950	20-10 990	21-2 1,030	21-7 1,060	21-11 1,100	22-8 1,170	23-4 1,240	
	24.0	17-0 990	17-5 1,040	17-10 1,090	18-2 1,130	18-6 1,170	18-10 1,220	19-2 1,260	19-10 1,340	20-5 1,420	
2 x 10	12.0	27-5 790	28-0 830	28-7 860	29-2 900	29-9 930	30-4 970	30- 10 1,000	31 - 10 1,070	32-9 1,130	
	16.0	24-10 870	25-5 910	26-0 950	26-6 990	27-1 1,030	27-6 1,060	28-0 1,100	28-11 1,170	29-9 1,240	
	24.0	21 -9 990	22-3 1,040	22-9 1,090	23-2 1,130	23-8 1,170	24- 1 1,220	24-6 1,260	25-3 1,340	26-0 1,420	

For SI: 1 inch = 25.4 mm, 1 pound per square inch = 6.895 kPa, 1 pound per square foot = 0.0479 kN/m2.
NOTE: The extreme fiber stress in bending, *"Fb,"* in pounds per square inch is shown below each span.

TABLE 3608.2.4dd
ALLOWABLE SPANS FOR CEILING JOISTS
10 Lbs per Sq. Ft. Live Load
(No attic storage and roof slope not steeper than 3 in 12)
(Gypsum Ceiling)

DESIGN CRITERIA: Deflection—For 10 Ibs. per sq. ft. live load. Limited to span in inches divided by 240. Strength—Live load of 10 Ibs. per *sq. Ft.* plus dead load of 5 lbs. per sq. ft. determines fiber stress value.

HOW TO USE TABLES: Enter table with span of joists (upper figure in each square). Determine size and spacing (first column) based stress grade (lower figure in each square) and modulus of elasticity (top row) of lumber to be used.

JOIST SIZE AND SPACING		MODULUS OF ELASTICITY, "*E*," IN 1,000,000 PSI									
(inches)	**(inches)**	**0.4**	**0.5**	**0.6**	**0.7**	**0.8**	**0.9**	**1.0**	**1.1**	**1.2**	**1.3**
2 x 4	12.0	7-10 450	8-5 520	8-11 590	9-5 650	9-10 710	10-3 770	10-7 830	10-11 880	11-3 930	11 -7 980
	16.0	7-1 490	7-8 570	8-1 650	8-7 720	8-11 780	9-4 850	9-8 910	9-11 970	10-3 1,030	10-6 1,080
	24.0	6-2 560	6-8 660	7-1 740	7-6 820	7-10 900	8-1 970	8-5 1,040	8-8 1,110	8-11 1,170	9-2 1,240
2 x 6	12.0	12-3 450	13-3 520	14-1 590	14-9 650	15-6 710	16-1 770	16-8 830	17-2 880	17-8 930	18-2 980
	16.0	11-2 490	12-0 570	12-9 650	13-5 720	14-1 780	14-7 850	15-2 910	15-7 970	16-1 1,030	16-6 1,080
	24.0	9-9 560	10-6 660	11-2 740	11-9 820	12-3 900	12-9 970	13-3 1,040	13-8 1,110	14-1 1,170	14-5 1,240
2x8	12.0	16-2 450	17-5 520	18-6 590	19-6 650	20-5 710	21-2 770	21-11 830	22-8 880	23-4 930	24-0 980
	16.0	14-8 490	15-10 570	16-10 650	17-9 720	18-6 780	19-3 850	19-11 910	20-7 970	21-2 1,030	21-9 1,080
	24.0	12-10 560	13-10 660	14-8 740	15-6 820	16-2 900	16-10 970	17-5 1,040	18-0 1,110	18-6 1,170	19-0 1,240
2x 10	12.0	20-8 450	22-3 520	23-8 590	24- 10 650	26-0 710	27- 1 770	28-0 830	28- 11 880	29-9 930	30-7 980
	16.0	18-9 490	20-2 570	21 -6 650	22-7 720	23-8 780	24-7 850	25 -5 910	26-3 970	27- 1 1,030	27-9 1,080
	24.0	16-5 560	17-8 660	18-9 740	19-9 820	20-8 900	21-6 970	22-3 1,040	22-11 1,110	23-8 1,170	24-3 1,240
(inches)	**(inches)**	**1.4**	**1.5**	**1.6**	**1.7**	**1.8**	**1.9**	**2.0**	**2.2**	**2.4**	
2 x 4	12.0	11-10 1,030	12-2 1,080	12-5 1,130	12-8 1,180	12-11 1,220	13-2 1,270	13-4 1,310	13-9 1,400	14-2 1,480	
	16.0	10-9 1,140	11-0 1,190	11 -3 1,240	11 -6 1,290	11-9 1,340	11-11 1,390	12-2 1,440	12-6 1,540	12- 11 1,630	
	24.0	9-5 1,300	9-8 1,360	9-10 1,420	10-0 1,480	10-3 1,540	10-5 1,600	10-7 1,650	10-11 1,760	11-3 1,860	
2 x 6	12.0	18-8 1,030	19-1 1,080	19-6 1,130	19-11 1,180	20-3 1,220	20-8 1,270	21-0 1,310	21-8 1,400	22-4 1,480	
	16.0	16-11 1,140	17-4 1,190	17-8 1,240	18-1 1,290	18-5 1,340	18-9 1,390	19-1 1,440	19-8 1,540	20-3 1,630	
	24.0	14-9 1,300	15-2 1,360	15-6 1,420	15-9 1,480	16-1 1,540	16-4 1,600	16-8 1,650	17-2 1,760	17-8 1,860	
2 x 8	12.0	24-7 1,030	25-2 1,080	25-8 1,130	26-2 1,180	26-9 1,220	27-2 1,270	27-8 1,310	28-7 1,400	29-5 1,480	
	16.0	22-4 1,140	22-10 1,190	23-4 1,240	23-10 1,290	24-3 1,340	24-8 1,390	25-2 1,440	25-11 1,540	26-9 1,630	
	24.0	19-6 1,300	19-11 1,360	20-5 1,420	20-10 1,480	21-2 1,540	21-7 1,600	21-11 1,650	22-8 1,760	23-4 1,860	
2 x 10	12.0	31-4 1,030	32-1 1,080	32-9 1,130	33-5 1,180	34-1 1,220	34-8 1,270	35-4 1,310	36-5 1,400	37-6 1,480	
	16.0	28-6 1,140	29-2 1,190	29-9 1,240	30-5 1,290	31 -0 1,340	31 -6 1,390	32- 1 1,440	33- 1 1,540	34- 1 1,630	
	24.0	24-10 1,300	25-5 1,360	26-0 1,420	26-6 1,480	27-1 1,540	27-6 1,600	28-0 1,650	28-11 1,760	29-9 1,860	

For SI: 1 inch = 25.4 mm, 1 pound per square inch = 6.895 kPa, 1 pound per square foot = 0.0479 kN/m2.

NOTE: The extreme fiber stress in bending, *"Fb,"* in pounds per square inch is shown below each span.

TABLE 3608.2.4a
ALLOWABLE SPANS FOR LOW OR HIGH SLOPE RAFTERS
25 Lbs. per Sq. Ft. Live Load
For Use in Snow Load Zone 1

DESIGN CRITERIA: Strength 25 lbs. per sq. ft. live load plus 10 lbs. per sq. ft. dead load determines fiber stress. Deflection—For 25 lbs. per sq. ft. live load. Limited to span in inches divided by 180.

RAFTERS: Spans are measured along the horizontal projection and loads are considered as applied on the horizontal projection

HOW TO USE TABLES: Enter table with span of rafters (upper figure in each square). Determine size and spacing (first column) based on stress grade (top row) and modulus of elasticity (lower figure in each square) of lumber to be used.

RAFTER SIZE AND SPACING		ALLOWABLE EXTREME FIBER STRESS IN BENDING, "*Fb*," (psi)									
(inches)	**(inches)**	**300**	**400**	**500**	**600**	**700**	**800**	**900**	**1000**	**1100**	**1200**
2 x 6	12.0	6-7 .12	7-7 .18	8-6 .25	9-4 .33	10-0 .41	10-9 .50	11-5 .60	12-0 .70	12-7 .81	13-2 .92
	16.0	5-8 .10	6-7 .15	7-4 .21	8-1 .28	8-8 .36	9-4 .43	9-10 .52	10-5 .61	10-11 .70	11-5 .80
	24.0	4-8 .08	5-4 .13	6-0 .18	6-7 .23	7-1 .29	7-7 .35	8-1 .42	8-6 .50	8-11 .57	9-4 .65
2 x 8	12.0	8-8 .12	10-0 .18	11-2 .25	12-3 .33	13-3 .41	14-2 .50	15-0 .60	15-10 .70	16-7 .81	17-4 .92
	16.0	7-6 .10	8-8 .15	9-8 .21	10-7 .28	11-6 .36	12-3 .43	13-0 .52	13-8 .61	14-4 .70	15-0 .80
	24. 0	6-2 .08	7-1 .13	7-11 .18	8-8 .23	9-4 .29	10-0 .35	10-7 .42	11-2 .50	11-9 .57	12-3 .65
2 x 10	12.0	11-1 .12	12-9 .18	14-3 .25	15.8 .33	16-11 .41	18-1 .50	19-2 .60	20-2 .70	21-2 .81	22-1 .92
	16.0	9-7 .10	11-1 .15	12-4 .21	13-6 .28	14-8 .36	15-8 .43	16-7 .52	17-6 .61	18-4 .70	19-2 .80
	24.0	7-10 .08	9-0 .13	10-1 .18	11-1 .23	11-11 .29	12-9 .35	13-6 .42	14-3 .50	15-0 .57	15-8 .65
2x 12	12.0	13-6 0.12	15-6 0.18	17-4 0.25	19-0 0.33	20-7 0.41	22-0 0.50	23-4 0.60	24-7 0.70	25-9 0.81	26-11 0.92
	16.0	11-8 0.10	13-5 0.15	15-0 0.21	16-6 0.28	17-9 0.36	19-0 0.43	20-2 0.52	21-3 0.61	22-3 0.70	23-3 0.92
	24.0	9-6 0.08	11-0 0.13	12-3 0.18	13-5 0.23	14-6 0.29	15-6 0.35	16-6 0.42	17-4 0.50	18-3 0.57	19-0 0.65
(inches)	**(inches)**	**1300**	**1400**	**1500**	**1600**	**1700**	**1800**	**1900**	**2000**	**2100**	**2200**
2 x 6	12. 0	13-8 1.04	14-2 1.16	14-8 1.29	15-2 1.42	15-8 1.55	16-1 1.69	16-7 1.84	17-0 1.98	17-5 2.13	17-10 2.29
	16.0	11-10 .90	12-4 1.01	12-9 1.12	13-2 1.23	13-7 1.35	13-11 1.47	14-4 1.59	14-8 1.72	15-1 1.85	15-5 1.98
	24.0	9-8 .74	10-0 .82	10-5 .91	10-9 1.00	11-1 1.10	11-5 1.20	11-8 1.30	12-0 1.40	12-4 1.51	12-7 1.62
2 x 8	12.0	18-0 1.04	18-9 1.16	19-5 1.29	20-0 1.42	20-8 1.55	21-3 1.69	21-10 1.84	22-4 1.98	22-11 2.13	23-6 2.29
	16.0	15-7 .90	16-3 1.01	16-9 1.12	17-4 1.23	17-10 1.35	18-5 1.47	18-11 1.59	19-5 1.72	19-10 1.85	20-4 1.98
	24.0	12-9 .74	13-3 .82	13-8 .91	14-2 1.00	14-7 1.10	15-0 1.20	15-5 1.30	15-10 1.40	16-3 1.51	16-7 1.62
2 x 10	12.0	23-0 1.04	23-11 1.16	24-9 1.29	25-6 1.42	26-4 1.55	27-1 1.69	27-10 1.84	28-7 1.98	28-3 2.13	30-0 2.29
	16.0	19-11 .90	20-8 1.01	21-5 1.12	22-1 1.23	22-10 1.35	23-5 1.47	24-1 1.59	24-9 1.72	25-4 1.85	25-11 1.98
	24.0	16-3 .74	16-11 .82	17-6 .91	18-1 1.00	18-7 1.10	19-2 1.20	19-8 1.30	20-2 1.40	20-8 1.51	21-2 1.62
2x 12	12.0	28-0 1.04	29-1 1.16	30-1 1.29	31-1 1.42	32-0 1.56	33-0 1.70	33-10 1.84	34-9 1.98	35-8 2.13	36-5 2.29
	16.0	24-3 0.90	25.2 1.01	26-0 1.12	26-10 1.23	27-9 1.35	28-6 1.47	29-2 1.59	30-0 1.72	30-9 1.85	31-6 1.98
	24.0	19-10 0.74	20-7 0.82	21-3 0.91	22-0 1.01	22-8 1.10	23-4 1.20	23-11 1.30	24-7 1.41	25-2 1.51	25-9 1.62

For SI: 1 inch = 25,4 mm, 1 pound per square inch = 6.895 kPa, 1 pound per square foot = 0.0479 kN/m2.

NOTE: The modulus of elasticity, "E," in 1,000,000 pounds per square inch is shown below each span.

TABLE 3608.2.4b
ALLOWABLE SPANS FOR LOW OR HIGH SLOPE RAFTERS
25 Lbs. per Sq. Ft. Live Load (Supporting Gypsum Wallboard Ceiling)
For Use in Snow Load Zone 1

DESIGN CRITERIA: Strength—25 Ibs. per sq.ft. live load plus 10 Ibs. per sq. ft. dead load determines fiber stress. Deflection—For 25 Ibs. per sq. ft. live load. Limited to span in inches divided by 240.

RAFTERS: Spans are measured along the horizontal projection and loads are considered as applied on the horizontal projection.

HOW TO USE TABLES: Enter table with span of rafters (upper figure in each square). Determine size and spacing (first column) based on stress grade (top row) and modulus of elasticity (lower figure in each square) of lumber to be used.

RAFTER SIZE AND SPACING		ALLOWABLE EXTREME FIBER STRESS IN BENDING, "*Fb*," (psi)									
(inches)	**(inches)**	**300**	**400**	**500**	**600**	**700**	**800**	**900**	**1000**	**1100**	**1200**
2 x 6	12.0	6-7 .15	7-7 .24	8-6 .33	9-4 .43	10-0 .55	10-9 .67	11-5 .80	12-0 .94	12-7 1.03	13-2 1.23
	16.0	5-8 .13	6-7 .20	7-4 .29	8-1 .38	8-8 .47	9-4 .58	9-10 .69	10-5 .81	10-11 .93	11-5 1.06
	24.0	4-8 .11	5-4 .17	6-0 .23	6-7 .31	7-1 .39	7-7 .47	8-1 .56	8-6 .66	8-11 .76	9-4 .87
2 x 8	12.0	8-8 .15	10-0 .24	11-2 .33	12-3 .43	13-3 .55	14-2 .67	15-0 .80	15-10 .94	16-7 1.08	17-4 1.23
	16.0	7-6 .13	8-8 .20	9-8 .29	10-7 .38	11-6 .47	12-3 .58	13-0 .69	13-8 .81	14-4 .93	15-0 1.06
	24. 0	6-2 .11	7-1 .17	7-11 .23	8-8 .31	9-4 .39	10-0 .47	10-7 .56	11-2 .66	11-9 .76	12-3 .87
2 x 10	12.0	11-1 .15	12-9 .24	14-3 .33	15-8 .43	16-11 .55	18-1 .67	19-2 .80	20-2 .94	21-2 1.08	22-1 1.23
	16.0	9-7 .13	11-1 .20	12-4 .29	13-6 .38	14-8 .47	15-8 .58	16-7 .69	17-6 .81	18-4 .93	19-2 1.06
	24.0	7-10 .11	9-0 .17	10-1 .23	11-1 .31	11-11 .39	12-9 .47	13-6 .56	14-3 .66	15-0 .76	15-8 .87
2x 12	12.0	13-5 .15	15-6 .24	17-4 .33	19-0 .43	20-6 .55	21-11 .67	23-3 .80	24-7 .94	25-9 1.08	26-11 1.23
	16.0	11-8 .13	13-5 .20	15-0 .29	16-6 .38	17-9 .47	19-0 .58	20-2 .69	21-3 .81	22-4 .93	23-3 1.06
	24.0	9-6 .11	11-0 .17	12-3 .23	13-5 .31	14-6 .39	15-6 .47	16-6 .56	17-4 .66	18-2 .76	19-0 .87
(inches)	**(inches)**	**1300**	**1400**	**1500**	**1600**	**1700**	**1800**	**1900**	**2000**	**2100**	**2200**
2 x 6	12. 0	13-8 1.39	14-2 1.55	14-8 1.72	15-2 1.89	15-8 2.07	16-1 2.26	16-7 2.45	17-0 2.65	17-5 2.85	17-10 3.06
	16.0	11-10 1.20	12-4 1.34	12-9 1.49	13-2 1.64	13-7 1.80	13-11 1.96	14-4 2.12	14-8 2.29	15-1 2.46	15-5 2.64
	24.0	9-8 .98	10-0 1.10	10-5 1.21	10-9 1.34	11-1 1.47	11-5 1.60	11-8 1.73	12-0 1.87	12-4 2.01	12-7 2.16
2 x 8	12.0	18-0 1.39	18-9 1.55	19-5 1.72	20-0 1.89	20-8 2.07	21-3 2.26	21-10 2.45	22-5 2.65	22-11 2.85	23-6 3.06
	16.0	15-7 1.20	16-3 1.34	16-9 1.49	17-4 1.64	17-10 1.80	18-5 1.96	18-11 2.12	19-5 2.29	19-10 2.46	20-4 2.64
	24.0	12-9 .98	13-3 1.10	13-8 1.21	14-2 1.34	14-7 1.47	15-0 1.60	15-5 1.73	15-10 1.87	16-3 2.01	16-7 2.16
2 x 10	12.0	23-0 1.39	23-11 1.55	24-9 1.72	25-6 1.89	26-4 2.07	27-2 2.26	27-10 2.45	28-7 2.65	29-3 2.85	29-11 3.06
	16.0	19-11 1.20	20-8 1.34	21-5 1.49	22-1 1.64	22-10 1.80	23-5 1.96	24-1 2.12	24-9 2.29	25-4 2.46	25-11 2.64
	24.0	16-3 .98	16-11 1.10	17-6 1.21	18-1 1.34	18-7 1.47	19-2 1.60	19-8 1.73	20-2 1.87	20-8 2.01	21-2 2.16
2x 12	12.0	28-0 1.39	29-1 1.55	30-1 1.72	31-1 1.89	32-0 2.07	32-11 2.26	33-9 2.45	34-9 2.65	35-7 2.85	36-6 3.06
	16.0	24-3 1.20	25-2 1.34	26-0 1.49	26-10 1.64	27-9 1.80	28-6 1.96	29-4 2.12	30-1 2.29	30-9 2.46	31-6 2.64
	24.0	19-10 .98	20-6 1.10	21-3 1.21	21-11 1.34	22-8 1.47	23-3 1.60	23-11 1.73	24-7 1.87	25-2 2.01	25-9 2.16

For SI: 1 inch = 25,4 mm, 1 pound per square inch = 6.895 kPa, 1 pound per square foot = 0.0479 kN/m2.

NOTE: The modulus of elasticity, "E," in 1,000,000 pounds per square inch is shown below each span.

TABLE 3608.2.4c

ALLOWABLE SPANS FOR LOW OR HIGH SLOPE RAFTERS

25 Lbs. per Sq. Ft. Live Load (Supporting Veneer Plaster Ceiling)

For Use in Snow Load Zone 1

DESIGN CRITERIA: Strength-25 lbs. per sq.ft. live load plus 10 lbs. per sq. ft. dead load determines fiber stress. Deflection—For 25 lbs. per sq. ft. live load. Limited to span in inches divided by 360.

RAFTERS: Spans are measured along the horizontal projection and loads are considered as applied on the horizontal projection.

HOW TO USE TABLES: Enter table with span of rafters (upper figure in each square). Determine size and spacing (first column) based on stress grade (top row) and modulus of elasticity (lower figure in each square) of lumber to be used.

RAFTER SIZE AND SPACING		ALLOWABLE EXTREME FIBER STRESS IN BENDING, "*Fb*," (psi)									
(inches)	**(inches)**	**300**	**400**	**500**	**600**	**700**	**800**	**900**	**1000**	**1100**	**1200**
2 x 6	12.0	6-7 .23	7-7 .35	8-6 .50	9-4 .65	10-0 .82	10-9 1.00	11-5 1.20	12-0 1.40	12-7 1.62	13-2 1.84
	16.0	5-8 .20	6-7 .31	7-4 .43	8-1 .56	8-8 .71	9-4 .87	9-10 1.04	10-5 1.21	10-11 1.40	11-5 1.60
	24.0	4-8 .16	5-4 .25	6-0 .35	6-7 .46	7-1 .58	7-7 .71	8-1 .85	8-6 .99	8-11 1.14	9-4 1.30
2 x 8	12.0	8-8 .23	10-0 .35	11-2 .50	12-3 .65	13-3 .82	14-2 1.00	15-0 1.20	15-10 1.40	16-7 1.62	17-4 1.84
	16.0	7-6 .20	8-8 .31	9-8 .43	10-7 .56	11-6 .71	12-3 .87	13-0 1.04	13-8 1.21	14-4 1.40	15-0 1.60
	24. 0	6-2 .16	7-1 .25	7-11 .35	8-8 .46	9-4 .58	10-0 .71	10-7 .85	11-2 .99	11-9 1.14	12-3 1.30
2 x 10	12.0	11-1 .23	12-9 .35	14-3 .50	15.8 .65	16-11 .82	18-1 1.00	19-2 1.20	20-2 1.40	21-2 1.62	22-1 1.84
	16.0	9-7 .20	11-1 .31	12-4 .43	13-6 .56	14-8 .71	15-8 .87	16-7 1.04	17-6 1.21	18-4 1.40	19-2 1.60
	24.0	7-10 .16	9-0 .25	10-1 .35	11-1 .46	11-11 .58	12-9 .71	13-6 .85	14-3 .99	15-0 1.14	15-8 1.30
2x 12	12.0	13-5 .23	15-6 .35	17-4 .50	19-0 .65	20-6 .82	21-11 1.00	23-3 1.20	24-7 1.40	25-9 1.62	26-11 1.84
	16.0	11-8 .20	13-5 .31	15-0 .43	16-6 .56	17-9 .71	19-0 .87	20-2 1.04	21-3 1.21	22-4 1.40	23-3 1.60
	24.0	9-6 .16	11-0 .25	12-3 .35	13-5 .46	14-6 .58	15-6 .71	16-6 .85	17-4 .99	18-2 1.14	19-0 1.30
(inches)	**(inches)**	**1300**	**1400**	**1500**	**1600**	**1700**	**1800**	**1900**	**2000**	**2100**	**2200**
2 x 6	12. 0	13-8 2.08	14-2 2.32	14-8 2.58	15-2 2.84	15-8 3.11	16-1 3.39	16-6 3.68	17-0 3.97	17-5 4.28	17-10 4.58
	16.0	11-10 1.80	12-4 2.01	12-9 2.23	13-2 2.46	13-7 2.69	13-11 2.93	14-4 3.18	14-8 3.44	15-1 3.70	15-5 3.96
	24.0	9-8 1.47	10-0 1.64	10-5 1.82	10-9 2.01	11-1 2.20	11-5 2.40	11-8 2.60	12-0 2.81	12-4 3.02	12-7 3.24
2 x 8	12.0	18-0 2.08	18-9 2.32	19-5 2.58	20-0 2.84	20-8 3.11	21-3 3.39	21-10 3.68	22-5 3.97	22-11 4.28	23-6 4.59
	16.0	15-7 1.80	16-3 2.01	16-9 2.23	17-4 2.46	17-10 2.69	18-4 2.93	18-10 3.18	19-4 3.44	19-10 3.70	20-4 3.97
	24.0	12-9 1.47	13-3 1.64	13-8 1.82	14-2 2.01	14-7 2.20	15-0 2.40	15-5 2.60	15-10 2.81	16-3 3.02	16-7 3.24
2 x 10	12.0	23-0 2.08	23-11 2.32	24-9 2.58	25-7 2.84	26-4 3.11	27-2 3.39	27-10 3.68	28-7 4.28	29-3 4.59	29-11 4.90
	16.0	19-11 1.80	20-8 2.01	21-5 2.23	22-1 2.46	22-9 2.69	23-5 2.93	24-1 3.18	24-9 3.44	25-4 3.70	25-11 3.97
	24.0	16-3 1.47	16-11 1.64	17-6 1.82	18-1 2.01	18-7 2.10	19-2 2.40	19-8 2.60	20-2 2.81	20-8 3.02	21-2 3.24
2x 12	12.0	28-0 2.08	29-1 2.33	30-2 2.58	31-1 2.84	32-0 3.11	32-11 3.39	33-11 3.68	34-9 3.97	35-7 4.28	36-5 4.59
	16.0	24-3 1.80	25-2 2.01	26-0 2.23	26-11 2.46	27-9 2.69	28-6 2.93	29-4 3.18	30-1 3.44	30-10 3.70	31-6 3.97
	24.0	19-10 1.47	20-6 1.64	21-3 1.82	21-11 2.01	22-8 2.20	23-3 2.40	23-11 2.60	24-7 2.81	25-2 3.02	25-9 3.24

For SI: 1 inch = 25,4 mm, 1 pound per square inch = 6.895 kPa, 1 pound per square foot = 0.0479 kN/m2.

NOTE: The modulus of elasticity, "E," in 1,000,000 pounds per square inch is shown below each span.

TABLE 3608.2.4d
ALLOWABLE SPANS FOR LOW OR HIGH SLOPE RAFTERS

25 Lbs. per Sq. Ft. Live Load
For Use in Snow Load Zone 1

DESIGN CRITERIA: Strength—25 Ibs. per sq. ft.live load plus 15 Ibs. per sq.ft. dead load determines fiber stress. Deflection—For 25 Ibs. per sq. ft. Iive load. Limited to span in inches divided by 180.

RAFTERS: Spans are measured along the horizontal projection and loads are considered as applied on the horizontal projection.

HOW TO USE TABLES: Enter table with span of rafters (upper figure in each square). Determine size and spacing (first column) based on stress grade (top row) and modulus of elasticity (lower figure in each square) of lumber to be used.

RAFTER SIZE AND SPACING		**ALLOWABLE EXTREME FIBER STRESS IN BENDING, "*Fb*," (psi)**									
(inches)	**(inches)**	**300**	**400**	**500**	**600**	**700**	**800**	**900**	**1000**	**1100**	**1200**
2 x 6	12.0	6-2 0.09	7-1 0.15	7-11 0.20	8-8 0.27	9-5 0.34	10-0 0.41	10-8 0.49	11-3 0.57	11-9 0.66	12-4 0.75
	16.0	5-4 .08	6-2 .13	6-10 .18	7-6 .23	8-2 .29	8-8 .36	9-3 .42	9-9 .50	10-2 .57	10-8 .65
	24.0	4-4 .07	5-0 .10	5-7 .14	6-2 .19	6-8 .24	7-1 .29	7-6 .35	7-11 .41	8-4 .47	8-8 .53
2 x 8	12.0	8-1 .09	9-4 .15	10-6 .20	11-6 .27	12-5 .34	13-3 .41	14-0 .49	14-10 .57	15-6 .66	16-3 .75
	16.0	7-0 .08	8-1 .13	9-1 .18	9-11 .23	10-9 .29	11-6 .36	12-2 .42	12-10 .50	13-5 .57	14-0 .65
	24. 0	5-9 .07	6-7 .10	7-5 .14	8-1 .19	8-9 .24	9-4 .29	9-11 .35	10-6 .41	11-0 .47	11-6 .53
2 x 10	12.0	10-4 .09	11-11 .15	13-4 .20	14-8 .27	15-10 .34	16-11 .41	17-11 .49	18-11 .57	19-10 .66	20-8 .75
	16.0	8-11 .08	10-4 .13	11-7 .18	12-8 .23	13-8 .29	14-8 .36	15-6 .42	16-4 .50	17-2 .57	17-11 .65
	24.0	7-4 .07	8-5 .10	9-5 .14	10-4 .19	11-2 .24	11-11 .29	12-8 .35	13-4 .41	14-0 .47	14-8 .53
2x 12	12.0	12-7 .09	14-6 .15	16-3 .20	17-9 .27	19-3 .34	20-6 .41	21-9 .49	23-0 .57	24-1 .66	25-2 .75
	16.0	10-11 .08	12-7 .13	14-1 .18	15-5 .23	16-8 .29	17-9 .36	18-10 .42	19-11 .50	20-10 .57	21-9 .65
	24.0	8-11 .07	10-3 .10	11-6 .14	12-7 .19	13-7 .24	14-6 .29	15-5 .35	16-3 .41	17-0 .47	17-9 .53
(inches)	**(inches)**	**1300**	**1400**	**1500**	**1600**	**1700**	**1800**	**1900**	**2000**	**2100**	**2200**
2 x 6	12. 0	12-10 .85	13-3 .95	13-9 1.05	14-2 1.16	14-8 1.27	15-1 1.39	15-6 1.50	15-11 1.62	16-3 1.75	16-8 1.87
	16.0	11-1 .74	11-6 .82	11-11 .91	12-4 1.01	12-8 1.10	13-1 1.20	13-5 1.30	13-9 1.41	14-1 1.51	14-5 1.63
	24.0	9-1 .60	9-5 .67	9-9 .75	10-0 .82	10-4 .90	10-8 .98	10-11 1.06	11-3 1.15	11-6 1.24	11-9 1.32
2 x 8	12.0	16-10 .85	17-6 .95	18-1 1.05	18-9 1.16	19-4 1.27	19-10 1.39	20-5 1.50	20-11 1.62	21-11 1.75	21-11 1.87
	16.0	14-7 .74	15-2 .82	15-8 .91	16-3 1.01	16-9 1.10	17-2 1.20	17-8 1.30	18-1 1.41	18-7 1.51	19-0 1.63
	24.0	11-11 .60	12-5 .67	12-10 .75	13-3 .82	13-8 .90	14-0 .98	14-5 1.06	14-10 1.15	15-2 1.24	15-6 1.32
2 x 10	12.0	21-6 .85	22-4 .95	23-1 1.05	23-11 1.16	24-7 1.27	25-4 1.39	26-0 1.50	26-8 1.62	27-4 1.75	28-0 1.87
	16.0	18-8 .74	19-4 .82	20-0 .91	20-8 1.01	21-4 1.10	21-11 1.20	22-6 1.30	23-1 1.41	23-8 1.75	24-3 1.63
	24.0	15-3 .60	15-10 .67	16-4 .75	16-11 .82	17-5 .90	17-11 .98	18-5 1.06	18-11 1.15	19-4 1.24	19-9 1.32
2x 12	12.0	26-2 0.85	27-2 0.95	28-2 1.05	29-1 1.16	29-11 1.27	30-10 1.39	31-8 1.50	32-6 1.62	33-3 1.75	34-1 1.87
	16.0	22-8 0.74	23-6 0.83	24-4 0.92	25-2 1.01	25-11 1.10	26-8 1.20	27-5 1.30	28-2 1.41	28-10 1.51	29-6 1.63
	24.0	18-6 0.60	19-2 0.67	19-10 0.75	20-6 0.82	21-2 0.90	21-9 0.98	22-4 1.06	22-11 1.15	23-6 1.24	24-1 1.32

For SI: 1 inch = 25,4 mm, 1 pound per square inch = 6.895 kPa, 1 pound per square foot = 0.0479 kN/m2.

NOTE: The modulus of elasticity, "E," in 1,000,000 pounds per square inch is shown below each span.

TABLE 3608.2.4e

ALLOWABLE SPANS FOR LOW OR HIGH SLOPE RAFTERS

25 Lbs. per Sq. Ft. Live Load (Supporting Gypsum Wallboard Ceiling)

For Use in Snow Load Zone 1

DESIGN CRITERIA: Strength-25 lbs. per sq. ft. live load plus 15 lbs. per sq.ft. dead load determines fiber stress. Deflection—For 25 lbs. per sq. ft. live load. Limited to span in inches divided by 240.

RAFTERS: Spans are measured along the horizontal projection and loads are considered as applied on the horizontal projection.

HOW TO USE TABLES: Enter table with span of rafters (upper figure in each square). Determine size and spacing (first column) based on stress grade (top row) and modulus of elasticity (lower figure in each square) of lumber to be used.

RAFTER SIZE AND SPACING		**ALLOWABLE EXTREME FIBER STRESS IN BENDING, "*Fb*," (psi)**									
(inches)	**(inches)**	**300**	**400**	**500**	**600**	**700**	**800**	**900**	**1000**	**1100**	**1200**
2 x 6	12.0	6-2 .13	7-1 .19	7-11 .27	8-8 .36	9-5 .45	10-0 .55	10-8 .65	11-3 .77	11-9 .88	12-4 1.01
	16.0	5-4 .11	6-2 .17	6-10 .23	7-6 .31	8-2 .39	8-8 .47	9-3 .57	9-9 .66	10-2 .76	10-8 .87
	24.0	4-4 .09	5-0 .14	5-7 .19	6-2 .25	6-8 .32	7-1 .39	7-6 .46	7-11 .54	8-4 .62	8-8 .71
2 x 8	12.0	8-1 .13	9-4 .19	10-6 .27	11-6 .36	12-5 .45	13-3 .55	14-0 .65	14-10 .77	15-6 .88	16-3 1.01
	16.0	7-0 .11	8-1 .17	9-1 .23	9-11 .31	10-9 .39	11-6 .47	12-2 .57	12-10 .66	13-5 .76	14-0 .87
	24. 0	5-9 .09	6-7 .14	7-5 .19	8-1 .25	8-9 .32	9-4 .39	9-11 .46	10-6 .54	11-0 .62	11-6 .71
2 x 10	12.0	10-4 .13	11-11 .19	13-4 .27	14-8 .36	15-10 .45	16-11 .55	17-11 .65	18-11 .77	19-10 .88	20-8 1.01
	16.0	8-11 .11	10-4 .17	11-7 .23	12-8 .31	13-8 .39	14-8 .47	15-6 .57	16-4 .66	17-2 .76	17-11 .87
	24.0	7-4 .09	8-5 .14	9-5 .19	10-4 .25	11-2 .32	11-11 .39	12-8 .46	13-4 .54	14-0 .62	14-8 .71
2x 12	12.0	12-7 .13	14-6 .19	16-3 .23	17-9 .36	19-3 .45	20-6 .55	21-9 .65	23-0 .77	24-1 .88	25-2 1.01
	16.0	10-11 .11	12-7 .17	14-1 .23	15-5 .31	16-8 .39	17-9 .47	18-10 .57	19-11 .66	20-10 .76	21-9 .87
	24.0	8-11 .09	10-3 .14	11-6 .19	12-7 .25	13-7 .32	14-6 .39	15-5 .46	16-3 .54	17-0 .62	17-9 .71
(inches)	**(inches)**	**1300**	**1400**	**1500**	**1600**	**1700**	**1800**	**1900**	**2000**	**2100**	**2200**
2 x 6	12. 0	12-10 1.13	13-3 1.27	13-9 1.41	14-2 1.55	14-8 1.70	15-1 1.85	15-6 2.00	15-11 2.17	16-3 2.33	16-8 2.5
	16.0	11-1 0.98	11-6 1.10	11-11 1.22	12-4 1.34	12-8 1.47	13-1 1.60	13-5 1.74	13-9 1.88	14-1 2.02	14-5 2.17
	24.0	9-1 0.80	9-5 0.90	9-9 0.99	10-0 1.10	10-4 1.20	10-8 1.31	10-11 1.42	11-3 1.53	11-6 1.65	11-9 1.77
2 x 8	12.0	16-10 1.13	17-6 1.27	18-1 1.41	18-9 1.55	19-4 1.70	19-10 1.85	20-5 2.00	20-11 2.17	21-6 2.33	21-11 2.50
	16.0	14-7 0.98	15-2 1.10	15-8 1.22	16-3 1.34	16-9 1.47	17-2 1.60	17-8 1.74	18-1 1.88	18-7 2.02	19-0 2.17
	24.0	11-11 0.80	12-5 0.90	12-10 0.99	13-3 1.10	13-8 1.20	14-0 1.31	14-5 1.42	14-10 1.53	15-2 1.65	15-5 1.77
2 x 10	12.0	21-6 1.13	22-4 1.27	23-1 1.41	23-11 1.55	24-7 1.70	25-4 1.85	26-0 2.00	26-9 2.17	27-4 2.33	28-0 2.50
	16.0	18-8 0.98	19-4 1.10	20-0 1.22	20-8 1.34	21-4 1.47	21-11 1.60	22-6 1.74	23-1 1.88	23-8 2.02	24-3 2.17
	24.0	15-3 0.80	15-10 0.90	16-4 0.99	16-11 1.10	17-5 1.20	17-11 1.31	18-5 1.42	18-11 1.53	19-4 1.65	19-10 1.77
2x 12	12.0	26-2 1.13	27-2 1.27	28-2 1.41	29-1 1.55	29-11 1.70	30-10 1.85	31-8 2.00	32-6 2.17	33-3 2.33	34-1 2.50
	16.0	22-8 0.98	23-6 1.10	24-4 1.22	25-2 1.34	25-11 1.47	26-8 1.60	27-5 1.74	28-1 1.88	28-10 2.02	29-6 2.17
	24.0	18-6 0.80	19-3 .90	19-11 .99	20-6 1.10	21-2 1.20	21-9 1.31	22-5 1.42	23-0 1.53	23-6 1.65	24-1 1.77

For SI: 1 inch = 25,4 mm, 1 pound per square inch = 6.895 kPa, 1 pound per square foot = 0.0479 kN/m2.

NOTE: The modulus of elasticity, "E," in 1,000,000 pounds per square inch is shown below each span.

TABLE 3608.2.4f
ALLOWABLE SPANS FOR LOW OR HIGH SLOPE RAFTERS

25 Lbs. per Sq. Ft. Live Load (Supporting Veneer Plaster Ceiling)
For Use in Snow Load Zone 1

DESIGN CRITERIA: Strength-25 Ibs. per sq. ft. live load plus 15 Ibs. per sq.ft. dead load determines fiber stress. Deflection—For 25 Ibs. per sq. ft. live load. Limited to span in inches divided by 360.

RAFTERS: Spans are measured along the horizontal projection and loads are considered as applied on the horizontal projection.

HOW TO USE TABLES: Enter table with span of rafters (upper figure in each square). Determine size and spacing (first column) based on stress grade (top row) and modulus of elasticity (lower figure in each square) of lumber to be used.

RAFTER SIZE AND SPACING		ALLOWABLE EXTREME FIBER STRESS IN BENDING, "*Fb*," (psi)									
(inches)	**(inches)**	**300**	**400**	**500**	**600**	**700**	**800**	**900**	**1000**	**1100**	**1200**
2 x 6	12.0	6-2 .19	7-1 .29	7-11 .41	8-8 .53	9-5 .67	10-0 .82	10-8 .98	11-3 1.15	11-9 1.32	12-4 1.51
	16.0	5-4 .16	6-2 .25	6-10 .35	7-6 .46	8-2 .58	8-8 .71	9-3 .85	9-9 .99	10-2 1.15	10-8 1.31
	24.0	4-4 .13	5-0 .21	5-7 .29	6-2 .38	6-8 .48	7-1 .58	7-6 .69	7-11 .81	8-4 .94	8-8 1.07
2 x 8	12.0	8-1 .19	9-4 .29	10-6 .41	11-6 .53	12-5 .67	13-3 .82	14-0 .98	14-10 1.15	15-6 1.32	16-3 1.51
	16.0	7-0 .16	8-1 .25	9-1 .35	9-11 .46	10-9 .58	11-6 .71	12-2 .85	12-10 .99	13-5 1.15	14-0 1.31
	24. 0	5-9 .13	6-7 .21	7-5 .29	8-1 .38	8-9 .48	9-4 .58	9-11 .69	10-6 .81	11-0 .94	11-6 1.07
2 x 10	12.0	10-4 .19	11-11 .29	13-4 .41	14-8 .53	15-10 .67	16-11 .82	17-11 .98	18-11 1.15	19-10 1.32	20-8 1.51
	16.0	8-11 .16	10-4 .25	11-7 .35	12-8 .46	13-8 58	14-8 .71	15-6 .85	16-4 .99	17-2 1.15	17-11 1.31
	24.0	7-4 .13	3-5 .21	9-5 .29	10-4 .38	11-2 .48	11-11 .58	12-8 .69	13-4 .81	14-0 .94	14-8 1.07
2x 12	12.0	12-7 .19	14-6 .29	16-3 .41	17-9 .53	19-3 .67	20-6 .82	21-9 .98	23-0 1.15	24-1 1.32	25-2 1.51
	16.0	10-11 .16	12-7 .25	14-1 .35	15-5 .46	16-8 .58	17-9 .71	18-10 .85	19-11 .99	20-10 1.15	21-9 1.31
	24.0	8-11 .13	10-3 .21	11-6 .29	12-7 .38	13-7 .48	14-6 .58	15-5 .69	16-3 .81	17-0 .94	17-9 1.07
(inches)	**(inches)**	**1300**	**1400**	**1500**	**1600**	**1700**	**1800**	**1900**	**2000**	**2100**	**2200**
2 x 6	12. 0	12-10 1.70	13-3 1.90	13-9 2.11	14-2 2.32	14-8 2.55	15-1 2.77	15-6 3.01	15-10 3.25	16-3 3.49	16-8 3.75
	16.0	11-1 1.47	.46 1.65	11-11 1.83	12-4 2.01	12-8 2.20	13-1 2.40	13-5 2.61	13-9 2.82	14-1 3.03	14-5 3.25
	24.0	9-1 1.20	9-5 1.34	9-9 1.49	10-0 1.64	10-4 1.80	10-8 1.96	10-11 2.13	11-3 2.30	11-6 2.47	11-9 2.65
2 x 8	12.0	16-10 1.70	17-6 1.90	18-1 2.11	18-9 2.32	19-4 2.55	19-10 2.77	20-5 3.01	20-11 3.25	21-5 3.49	21-11 3.75
	16.0	14-7 1.47	15-2 1.65	15-8 183	16-3 2.01	16-9 2.20	17-2 2.40	17-8 2.61	18-2 2.82	18-7 3.03	19-0 3.25
	24.0	11-11 1.20	12-5 1.34	12-10 1.49	13-3 1.64	13-8 1.80	14-0 1.96	14-5 2.13	14-10 2.30	15-2 2.47	15-6 2.65
2 x 10	12.0	21-6 1.70	22-4 1.90	23-1 2.11	23-11 2.32	24-7 2.55	25-4 2.77	26-0 3.01	26-9 3.25	27-4 3.49	28-0 3.75
	16.0	18-8 1.47	19-4 1.65	20-0 1.83	20-8 2.01	21-4 2.20	21-11 2.40	22-6 2.61	23-2 2.82	23-9 3.03	24-3 3.25
	24.0	15-3 1.20	15-10 1.34	16-4 1.49	16-11 1.64	17-5 1.80	17-11 1.96	18-5 2.13	18-11 2.30	19-4 2.47	19-10 2.65
2x 12	12.0	26-2 1.70	27-2 1.90	28-2 2.11	29-1 2.32	29-11 2.55	30-10 2.77	31-8 3.01	32-6 3.25	33-3 3.49	34-1 3.75
	16.0	22-8 1.47	23-6 1.65	24-4 1.83	25-2 2.01	25-11 2.20	26-8 2.40	27-5 2.61	28-2 2.82	28-10 3.03	29-6 3.25
	24.0	18-6 1.20	19-3 1.34	19-11 1.49	20-6 1.64	21-2 1 80	21-9 1.96	22-5 2.13	23-0 2.30	23-6 2.47	24-1 2.65

For SI: 1 inch = 25.4 mm, 1 pound per square inch = 6.895 kPa, 1 pound per square foot = 0.0479 kN/m2.

NOTE: The modulus of elasticity, "E," in 1,000,000 pounds per square inch is shown below each span.

TABLE 3608.2.4g

ALLOWABLE SPANS FOR LOW OR HIGH SLOPE RAFTERS

30 Lbs. per Sq. Ft. Live Load

For Use in Snow Load Zone 2

DESIGN CRITERIA: Strength—10 Ibs. per sq. fl. dead load plus 30 Ibs. per sq. ft. Iive load determines fiber stress. Deflection—For 30 Ibs. per sq. ft. Iive load. Limited to span in inches divided by 180.

RAFTERS: Spans are measured along the horizontal projection and loads are considered as applied on the horizontal projection.

HOW TO USE TABLES: Enter table with span of rafters (upper figure in each square). Determine size and spacing (last column) based on stress grade (top row) and modulus of elasticity (lower figure in each square) of lumber to be used.

RAFTER SIZE AND SPACING		ALLOWABLE EXTREME FIBER STRESS IN BENDING, "*Fb*," (psi)										
(inches)	**(inches)**	**300**	**400**	**500**	**600**	**700**	**800**	**900**	**1000**	**1100**	**1200**	**1300**
2 x 6	12.0	6-2 0.11	7-1 0.17	7-11 0.24	8-8 0.32	9-4 0.40	10-0 0.49	10-8 0.59	11-3 0.69	11-9 0.80	12-4 0.91	12-9 1.02
	16.0	5-4 0.10	6-2 0.15	6-10 0.21	7-6 0.28	8-2 0.35	8-8 0.43	9-3 0.51	9-9 0.60	10-2 0.69	10-8 0.78	11-1 0.88
	24. 0	4-4 0.08	5-0 0.12	5-8 0.17	6-2 0.23	6-8 0.29	7-1 0.35	7-6 0.42	7-11 0.49	8-4 0.56	8.8 0.64	9-1 0.72
2 x 8	12.0	8-1 0.11	9-4 0.17	10-6 0.24	11-6 0.32	12-4 0.40	13-3 0.49	14-1 0.59	14-10 0.69	15-6 0.80	16-3 0.91	16-10 1.02
	16.0	7-0 0.10	8-1 0.15	9-1 0.21	9-11 0.28	10-9 0.35	11-6 0.43	12-2 0.51	12-10 0.60	13-6 0.69	14-1 0.78	14-8 0.88
	24.0	5-9 0.08	6-8 0.12	7-5 0.17	8-1 0.23	8-9 0.29	9-4 0.35	9-11 0.42	10-6 0.49	11-0 0.56	11-6 0.64	11-11 0.72
2x 10	12.0	10-4 0.11	11-11 0.17	13-4 0.24	14-8 0.32	15-10 0.40	16-11 0.49	17-11 0.59	18-11 0.69	19-11 0.80	20-8 0.91	21-6 1.02
	16.0	8-11 0.10	10-4 0.15	11-7 0.21	12-8 0.28	13-8 0.35	14-8 0.43	15-6 0.51	16-4 0.60	17-2 0.69	17-11 0.78	18-8 0.88
	24.0	7-4 0.08	8.5 0.12	9-5 0.17	10-4 0.23	11-2 0.29	11-11 0.35	12-8 0.42	13-4 0.49	14-0 0.56	14-8 0.64	15-3 0.72
2 x 12	12. 0	12-7 0.11	14-6 0.17	16-3 0.24	17-9 0.32	19-3 0.40	20-6 0.49	21-10 0.59	22-11 0.69	24-1 0.80	25-2 0.91	26-2 1.02
	16. 0	10-11 0.10	12-7 0.15	14-1 0.21	15-5 0.28	16-8 0.35	17-10 0.43	18-10 0.51	19-11 0.60	20-10 0.69	21-10 0.78	22-8 0.88
	24. 0	8-10 0.08	10-3 0.12	11-6 0.17	12-7 0.23	13-7 0.29	14-6 0.35	15-5 0.42	16-3 0.49	17-0 0.56	17-9 0.64	18-6 0.72
(inches)	**(inches)**	**1400**	**1500**	**1600**	**1700**	**1800**	**1900**	**2000**	**2100**	**2200**	**2300**	**2400**
2 x 6	12.0	13-3 1.14	13-9 1.27	14-3 1.40	14-8 1.53	15-1 1.67	15-6 1.81	15-10 1.95	16-3 2.10	16-8 2.25	17-0 2.41	17-5 2.57
	16.0	11-6 0.99	11-11 1.10	12-4 1.21	12-8 1.32	13-1 1.44	13-5 1.56	13-9 1.69	14-1 1.82	14-6 1.95	14-9 2.08	15-1 2.22
	24.0	9-5 0.81	9-9 0.89	10-0 0.99	10-4 1.08	10-8 1.18	10-11 1.27	11-3 1.38	11-6 1.48	11.9 1.59	12-0 1.70	12-3 1.81
2 x 8	12.0	17-6 1.14	18-2 1.27	18-9 1.40	19-4 1.53	19-10 1.67	20-5 1.81	20-11 1.95	21-6 2.10	21-11 2.25	22-6 2.41	22-11 2.57
	16.0	15-2 0.99	15-7 1.10	16-3 1.21	16-9 1.32	17-2 1.44	17-8 1.56	18-2 1.69	18-7 1.82	19-0 1.95	19-5 2.08	19-10 2.22
	24.0	12-4 0.81	12-10 0.89	13-3 0.99	13-8 1.08	14-0 1.18	14-5 1.27	14-9 1.38	15-2 1.48	15-6 1.59	15-10 1.70	16-3 1.81
2 x 10	12.0	22-4 1.14	23-2 1.27	23-11 1.40	24-8 1.53	25-4 1.67	26-0 1.81	26-9 1.95	27-5 2.10	28-0 2.25	28-8 2.41	29-3 2.57
	16.0	19-4 0.99	20-0 1.10	20-8 1.21	21-4 1.32	21-11 1.44	22-7 1.56	32-2 1.69	23-9 1.82	24-3 1.95	24-10 2.08	25-4 2.22
	24.0	15-9 0.81	16-4 0.89	16-10 0.99	17-5 1.08	19-11 1.18	18-5 1.27	18-10 1.38	19-4 1.48	19-9 1.59	20-3 1.70	20-8 1.81
2x 12	12.0	27-2 1.14	28-1 1.27	29-1 1.40	29-11 1.53	30-10 1.67	31-8 1.81	32-6 1.95	33-3 2.10	34-1 2.25	34-10 2.41	35-7 2.57
	16.0	23-6 0.99	24-4 1.10	25-2 1.21	25-11 1.32	26-8 1.44	27-5 1.56	28-2 1.69	28-10 1.82	29-6 1.95	30-2 2.08	30-10 2.22
	24.0	19-3 0.81	19-10 0.89	20-6 0.99	21-2 1.08	21-9 1.18	22-4 1.27	22-11 1.38	23-6 1.48	24-1 1.59	24-9 1.70	25-2 1.81

For SI: 1 inch = 25.4 mm, 1 pound per square inch = 6.895 kPa, 1 pound per square foot = 0.0479 kN/mZ.

NOTE: The modulus of elasticity, "E," in 1,000,000 pounds per square inch is shown below each span.

TABLE 3608.2.4h
ALLOWABLE SPANS FOR LOW OR HIGH SLOPE RAFTERS

30 Lbs. per Sq. Ft. Live Load (Supporting Gypsum Ceiling)
For Use in Snow Load Zone 2

DESIGN CRITERIA: Strength—10 lbs. per sq. ft. dead load plus 30 lbs. per sq. ft. live load determines fiber stress. Deflection—For 30 lbs. per sq. ft. live load. Limited to span in inches divided by 240.

RAFTERS: Spans are measured along the horizontal projection and loads are considered as applied on the horizontal projection.

HOW TO USE TABLES: Enter table with span of rafters (upper figure in each square). Determine size and spacing (last column) based on stress grade (top row) and modulus of elasticity (lower figure in each square) of lumber to be used.

RAFTER SIZE AND SPACING		ALLOWABLE EXTREME FIBER STRESS IN BENDING, "*Fb*," (psi)										
(inches)	**(inches)**	**300**	**400**	**500**	**600**	**700**	**800**	**900**	**1000**	**1100**	**1200**	**1300**
2 x 6	12.0	6-2 0.15	7-1 0.23	7-11 0 32	8-8 0.43	9-5 0.54	10-0 0.66	10-8 0.78	11-3 0.92	11-9 1.06	124 1.21	12-10 1.36
	16.0	5-4 0.13	6-2 0.20	6-11 0.28	7-6 0.37	8-2 0.47	8-8 0.57	9-3 0.68	9- 9 0.80	10-2 0.92	10-8 1.05	11-1 1.18
	24. 0	4-4 0.11	5-0 0.16	5-7 0.23	6-2 0.30	6-8 0.38	7-1 0.46	7-6 0.55	7-11 0.65	8-4 0.75	8-8 0.85	9-1 0.96
2 x 8	12.0	8-1 0.15	9-4 0.23	10-6 0.32	11-6 0.43	12-5 0.54	13-3 0.66	14-0 0.78	14-10 0.92	15-6 1.06	16-3 1.21	16-10 1.36
	16.0	7-0 0.13	8-1 0.20	9-1 0.28	9-11 0.37	10-9 0.47	11-6 0.57	12-2 0.68	12-10 0.80	13-5 0.92	14-0 1.05	14-7 1.18
	24.0	5-9 0.11	6-7 0.16	7-5 0.23	8-1 0.30	8-9 0.38	9-4 0.46	9-11 0.55	10-6 0.65	11-0 0.75	11-6 0.85	11-11 0.96
2x 10	12.0	10-4 0.15	11-11 0.23	13-4 0.32	14-8 0.43	15-10 0.54	16-11 0.66	17-11 0.78	18-11 0.92	19-10 1.06	20-8 1.21	21-6 1.36
	16.0	8-11 0.13	10-4 0.20	11-7 0.28	12-8 0.37	13-8 0.47	14-8 0.57	15-6 0.68	16-4 0.80	17-2 0.92	17-11 1.05	18-8 1.18
	24.0	7-4 0.11	8-5 0.16	9-5 0.23	10-4 0.30	11-2 0.38	11-11 0.46	12-8 0.55	134 0.65	14-0 0.75	14-8 0.85	15-3 0.96
2 x 12	12. 0	12-7 0.15	14-6 0.23	16-3 0.32	17-9 0.43	19-3 0.54	20-6 0.66	21-9 0.78	23-0 0.92	24-1 1.06	25-2 1.21	26-2 1.36
	16. 0	10-11 0.13	12-7 0.20	14-1 0.28	15-5 0.37	16-8 0.47	17-9 0.57	18-10 0.68	19-11 0.80	20-10 0.92	21-9 1.05	22-8 1.18
	24. 0	8-11 0.11	10-3 0.16	11-6 0.23	12-7 0.30	13-7 0.38	14-6 0.46	15-5 0.55	16-3 0.65	17-0 0.75	17-9 0.85	18-6 0.96
(inches)	**(inches)**	**1400**	**1500**	**1600**	**1700**	**1800**	**1900**	**2000**	**2100**	**2200**	**2400**	
2 x 6	12.0	13-3 1.52	13-9 1.69	14-2 1.86	14-8 2.04	15-1 2.22	15-6 2.41	15-11 2.60	16-3 2.80	16-8 3.00	17-5 3.42	
	16.0	11-6 1.32	11-11 1.46	12-4 1.61	12-8 1.76	13-1 1.92	13-5 2.08	13-9 2.25	14-1 2.42	14-5 2.60	15-1 2.96	
	24.0	9-5 1.08	9 9 1.19	10-0 1.31	10-4 1.44	10-8 1.57	10-11 1.70	11-3 1.84	11-6 1.98	11-9 2.12	12-4 2.41	
2 x 8	12.0	17-6 1.52	18 2 1.69	18-9 1.86	19-4 2.04	19-10 2.22	20-5 2.41	20-11 2.60	21-5 2.80	21-11 3.00	22-11 3.42	
	16.0	15-2 1.32	15-8 1.46	16-3 1.61	16-9 1.76	17-2 1.92	17-8 2.08	18-2 2.25	18-7 2.42	19-0 2.60	19-10 2.96	
	24.0	12-5 1.08	12-10 1.19	13-3 1.31	13-8 1.44	14-0 1.57	14-5 1.70	14-10 1.84	15-2 1.98	15-6 2.12	16-3 2.41	
2 x 10	12.0	22-4 1.52	23-2 1.69	23-11 1.86	24-7 2.04	25-4 2.22	26-0 2.41	26-8 2.60	27-4 2.80	28-0 3.00	29-3 3.42	
	16.0	19-4 1.32	20-0 1.46	20-8 1.61	21-4 1.76	21-11 1.92	22-6 2.08	23-2 2.25	23-8 2.42	24-3 2.60	25-4 2.96	
	24.0	15-10 1.08	16-4 1.19	16-11 1.31	17-5 1.44	17-11 1.57	18-5 1.70	18-11 1.84	19-4 1.98	19-10 2.12	20-8 2.41	
2x 12	12.0	27-2 1.52	28-2 1.69	29- 1 1.86	29- 11 2.04	30- 10 2.22	31 -8 2.41	32-6 2.60	33-3 2.80	34-1 3.00	35-7 3.42	
	16.0	23-6 1.32	24-4 1.46	25-2 1.61	25-11 1.76	26-8 1.92	27-5 2.08	28-2 2.25	28-10 2.42	29-6 2.60	30-10 2.96	
	24.0	19-3 1.08	19-11 1.19	20-6 1.31	21-2 1.44	21-9 1.57	22-5 1.70	23-0 1.84	23-6 1.98	24-1 2.12	25-2 2.41	

For Sl: 1 inch = 25.4 mm, 1 pound per square inch = 6.895 kPa, 1 pound per square foot = 0.0479 kN/mZ.

NOTE: The modulus of elasticity, "E," in 1,000,000 pounds per square inch is shown below each span.

TABLE 3608.2.4i
ALLOWABLE SPANS FOR LOW OR HIGH SLOPE RAFTERS

30 Lbs. per Sq. Ft. Live Load (Supporting Veneer Plaster Ceiling)

For Use in Snow Load Zone 2

DESIGN CRITERIA: Strength—10 lbs. per sq. ft. dead load plus 30 lbs. per sq. ft. live load determines fiber stress. Deflection—For 30 lbs. per sq. ft. live load. Limited to span in inches divided by 360.

RAFTERS: Spans are measured along the horizontal projection and loads are considered as applied on the horizontal projection.

HOW TO USE TABLES: Enter table with span of rafters (upper figure in each square). Determine size and spacing (last column) based on stress grade (top row) and modulus of elasticity (lower figure in each square) of lumber to be used.

RAFTER SIZE AND SPACING		ALLOWABLE EXTREME FIBER STRESS IN BENDING, "*Fb*," (psi)										
(inches)	**(inches)**	**300**	**400**	**500**	**600**	**700**	**800**	**900**	**1000**	**1100**	**1200**	**1300**
2 x 6	12.0	6-2 0.23	7-1 0.35	7-11 0.49	8-8 0.64	9-5 0.81	10-0 0.99	10-8 1.18	11-3 1.38	11-9 1.59	12-3 1.81	12-10 2.04
	16.0	5-4 0.20	6-2 0.30	6-10 0.42	7-6 0.55	8-2 0.70	8-8 0.85	9-3 1.02	9-9 1.19	10-2 1.38	10-8 1.57	11-1 1.77
	24. 0	4-4 0.16	5-0 0.25	5-7 0.34	6-2 0.45	6-8 0.57	7-1 0.70	7-6 0.83	7-11 0.97	8-4 1.12	8-8 1.28	9-1 1.44
2 x 8	12.0	8-1 0.23	9-4 0.35	10-6 0.49	11-5 0.64	12-4 0.81	13-3 0.99	14-1 1.18	14-10 1.38	15-6 1.59	16-3 1.81	16-10 2.04
	16.0	7-0 0.20	8-1 0.30	9-1 0.42	9-11 0.55	10-9 0.70	11-6 0.85	12-2 1.02	12-10 1.19	13-5 1.38	14-0 1.57	14-8 1.77
	24.0	5-9 0.16	6-7 0.25	7-5 0.34	8-1 0.45	8-9 0.57	9-4 0.70	9-11 0.83	10-6 0.97	11-0 1.12	11-6 1.28	11-11 1.44
2x 10	12.0	10-4 0.23	11-11 0.35	13-4 0.49	14-8 0.64	15-10 0.81	16-11 0.99	17-11 1.18	18-11 1.38	19-11 1.59	20-8 1.81	21-6 2.04
	16.0	8-11 0.20	10-4 0.30	11-7 0.42	12-8 0.55	13-8 0.70	14-7 0.85	15-6 1.02	16-4 1.19	17-2 1.38	17-11 1.57	18-8 1.77
	24.0	7-4 0.16	8-5 0.25	9-5 0.34	10-4 0.45	11-2 0.57	11-11 0.70	12-8 0.83	13-4 0.97	14-0 1.12	14-8 1.28	15-3 1.44
2 x 12	12. 0	12-7 0.23	14-6 0.35	16-3 0.49	17-10 0.64	19-3 0.81	20-6 0.99	21-9 1.18	23-0 1.38	24-1 1.59	25-2 1.81	26-2 2.04
	16. 0	10-11 0.20	12-7 0.30	14-1 0.42	15-5 0.55	16-8 0.70	17-9 0.85	18-10 1.02	19-11 1.19	20-10 1.38	21-9 1.57	22-8 1.77
	24. 0	8-11 0.16	10-3 0.25	11-6 0.34	12-7 0.45	13-7 0.57	14-6 0.70	15-5 0.83	16-3 0.97	17-0 1.12	17-9 1.28	18-6 1.44
(inches)	**(inches)**	**1400**	**1500**	**1600**	**1700**	**1800**	**1900**	**2000**	**2100**	**2200**	**2300**	**2400**
2 x 6	12.0	13-3 2.29	13-9 2.53	14-3 2.79	14-8 3.06	15-1 3.33	15-6 3.61	15-10 3.90	16-3 4.20	16-8 4.50	17-0 4.81	17-5 5.13
	16.0	11-6 1.98	11-11 2.19	12-4 2.42	12-8 2.65	13-0 2.88	13-5 3.13	13-9 3.38	14-1 3.63	14-5 3.89	14-9 4.16	15-1 4.44
	24.0	9-4 1.61	9-9 1.79	10-0 1.97	10-4 2.16	10-8 2.35	10-11 2.55	11-3 2.75	11-6 2.96	11-9 3.18	12-0 3.39	12-3 3.62
2 x 8	12.0	17-6 2.29	18-1 2.53	18-9 2.79	19-3 3.06	19-10 3.33	20-5 3.61	20-11 3.90	21-5 4.20	21-11 4.50	22-5 4.81	22-11 5.13
	16.0	15-2 1.98	15-8 2.19	16-3 2.42	16-9 2.65	17-3 2.88	17-8 3.13	18-1 3.38	18-7 3.63	19-0 3.89	19-5 4.16	19-10 4.44
	24.0	12-4 1.61	12-10 1.79	13-3 1.97	13-8 2.16	14-0 2.35	14-5 2.55	14-9 2.75	15-2 2.96	15-6 3.18	15-10 3.39	16-3 3.62
2 x 10	12.0	22-4 2.29	23-1 2.53	23-10 2.79	24-7 3.06	25-4 3.33	26-0 3.61	26-9 3.90	27-4 4.20	28-0 4.50	28-8 4.81	29-3 5.13
	16.0	19-4 1.98	20-0 2.19	20-8 2.42	21-4 2.65	21-11 2.88	22-7 3.13	23-2 3.38	23-9 3.63	24-3 3.89	24-10 4.16	25-4 4.44
	24.0	15-9 1.61	16-4 1.79	16-10 1.97	17-5 2.16	19-11 2.35	18-5 2.55	18-10 2.75	19-4 2.96	19-10 3.18	20-3 3.39	20-8 3.62
2x 12	12.0	27-2 2.29	28-1 2.53	29-1 2.79	29-11 3.06	30-10 3.33	31-8 3.61	32-6 3.90	33-3 4.20	34-1 4.50	34-10 4.81	35-7 5.13
	16.0	23-6 1.98	24-4 2.19	25-2 2.42	25-11 2.65	26-8 2.88	27-5 3.13	28-2 3.38	28-10 3.63	29-6 3.89	30-2 4.16	30-10 4.44
	24.0	19-2 1.61	19-10 1.79	20-6 1.97	21-2 2.16	21-9 2.35	22-4 2.55	22-11 2.75	23-6 2.96	24-1 3.18	24-7 3.39	25-2 3.62

For SI: 1 inch = 25.4 mm, 1 pound per square inch = 6.895 kPa, 1 pound per square foot = 0.0479 kN/mZ.

NOTE: The modulus of elasticity, "E," in 1,000,000 pounds per square inch is shown below each span.

TABLE 3608.2.4j
ALLOWABLE SPANS FOR LOW OR HIGH SLOPE RAFTERS
30 Lbs. per Sq. Ft. Live Load
For Use in Snow Load Zone 2

DESIGN CRITERIA: Strength—15 lbs. per sq. ft. dead load plus 30 lbs. per sq. ft. live load determines fiber stress. Deflection—For 30 lbs. per sq. ft. live load. Limited to span in inches divided by 180.

RAFTERS: Spans are measured along the horizontal projection and loads are considered as applied on the horizontal projection.

HOW TO USE TABLES: Enter table with span of rafters (upper figure in each square). Determine size and spacing (last column) based on stress grade (top row) and modulus of elasticity (lower figure in each square) of lumber to be used.

RAFTER SPACING AND SIZE		ALLOWABLE EXTREME FIBER STRESS IN BENDING, "*Fb*," (psi)											
(inches)	**(inches)**	**200**	**300**	**400**	**500**	**600**	**700**	**800**	**900**	**1000**	**1100**	**1200**	**1300**
2 x 4	12.0	3-0 0.05	3-8 0.09	4-3 0.15	4-9 0.20	5-3 0.27	5-8 0.34	6-0 0.41	6-5 0.49	6-9 0.58	7-1 0.67	7-5 0.76	7-8 0.86
	16.0	2-7 0.04	3-2 0.08	3-8 0.13	4-1 0.18	4-6 0.23	4-11 0.29	5-3 0.36	5-6 0.43	5-10 0.50	6-1 0.58	6-5 0.66	6-8 0.74
	24.0	2-2 0.04	2-7 0.07	3-0 0.10	3-4 0.14	3-8 0.19	4-0 0.24	4-3 0.29	4-6 0.35	4-9 0.41	5-0 0.47	5-3 0.54	5-5 0.61
2x6	12.0	4-9 0.05	5-10 0.09	6-8 0.15	7-6 0.20	8-2 0.27	8-10 0.34	9-6 0.41	10-0 0.49	10-7 0.58	11-1 0.67	11-7 0.76	12-1 0.86
	16.0	4-1 0.04	5-0 0.08	5-10 0.13	6-6 0.18	7-1 0.23	7-8 0.29	8-2 0.36	8-8 0.43	9-2 0.50	9-7 0.58	10-0 0.66	10-5 0.74
	24.0	3-4 0.04	4-1 0.07	4-9 0.10	5-4 0.14	5-10 0.19	6-3 0.24	6-8 0.29	7-1 0.35	7-6 0.41	7-10 0.47	8-2 0.54	8-6 0.61
2 x 8	12.0	6-3 0.05	7-8 0.09	8-10 0.15	9-10 0.20	10-10 0.27	11-8 0.34	12-6 0.41	13-3 0.49	13-11 0.58	14-8 0.67	15-3 0.76	15-11 0.86
	16.0	5-5 0.04	6-7 0.08	7-8 0.13	8-7 0.18	9-4 0.23	10-1 0.29	10-10 0.36	11-6 0.43	12-1 0.50	12-8 0.58	13-3 0.66	13-9 0.74
	24.0	4-5 0.04	5-5 0.07	6-3 0.10	7-0 0.14	7-8 0.19	8-3 0.24	8-10 0.29	9-4 0.35	9-10 0.41	10-4 0.47	10-10 0.54	11-3 0.61
2x 10	12.0	8-0 0.05	9-9 0.09	11-3 0.15	12-7 0.20	13-9 0.27	14-11 0.34	15-11 0.41	16-11 0.49	17-10 0.58	18-8 0.67	19-6 0.76	20-4 0.86
	16.0	6-11 0.04	8-5 0.08	9-9 0.13	10-11 0.18	11-11 0.23	12-11 0.29	13-9 0.36	14-8 0.43	15-5 0.50	16-2 0.58	16-11 0.66	17-7 0.74
	24.0	5-8 0.04	6-11 0.07	8-0 0.10	8-11 0.14	9-9 0.19	10-6 0.24	11-3 0.29	11-11 0.35	12-7 0.41	13-2 0.47	13-9 0.54	14-4 0.61
(inches)	**(inches)**	**1400**	**1500**	**1600**	**1700**	**1800**	**1900**	**2000**	**2100**	**2200**	**2400**	**2700**	**3000**
2 x4	12.0	8-0 0.96	8-3 1.06	8-6 1.17	8-9 1.28	9-0 1.39	9-3 1.51	9-6 1.63	9-9 1.76	10-0 1.88	10-5 2.15	11-1 2.56	
	16.0	6-11 0.83	7-2 0.92	7-5 1.01	7-7 1.11	7-10 1.21	8-0 1.31	8-3 1.41	8-5 1.52	8-8 1.63	9-0 1.86	9-7 2.22	10-1 2.60
	24.0	5-8 0.68	5-10 0.75	6-0 0.83	6-3 0.90	6-5 0.99	6-7 1.07	6-9 1.15	6-11 1.24	7-1 1.33	7-5 1.52	7-10 1.81	8-3 2.12
2 x 6	12.0	12-6 0.96	13-0 1.06	13-5 1.17	13-10 1.28	14-2 1.39	14-7 1.51	15-0 1.63	15-4 1.76	15-8 1.88	16-5 2.15	17-5 2.56	
	16.0	10-10 0.83	11-3 0.92	11-7 1.01	11-11 1.11	12-4 1.21	12-8 1.31	13-0 1.41	13-3 1.52	13-7 1.63	14-2 1.86	15-1 2.22	15-11 2.60
	24.0	8-10 0.68	9-2 0.75	9-6 0.83	9-9 0.90	10-0 0.99	10-4 1.07	10-7 1.15	10-10 1.24	11-1 1.33	11-7 1.52	12-4 1.81	13-0 2.12
2x8	12.0	16-6 0.96	17-1 1.06	17-8 1.17	18-2 1.28	18-9 1.39	19-3 1.51	19-9 1.63	20-3 1.76	20-8 1.88	21-7 2.15	22-11 2.56	
	16.0	14-4 0.83	14-10 0.92	15-3 1.01	15-9 1.11	16-3 1.21	16-8 1.31	17-1 1.41	17-6 1.52	17-11 1.63	18-9 1.86	19-10 2.22	20-11 2.60
	24.0	11-8 0.68	12-1 0.75	12-6 0.83	12-10 0.90	13-3 0.99	13-7 1.07	13-11 1.15	14-4 1.24	14-8 1.33	15-3 1.52	16-3 1.81	17-1 2.12
2x 10	12.0	21-1 0.96	21-10 1.06	22-6 1.17	23-3 1.28	23-11 1.39	24-6 1.51	25-2 1.63	25-10 1.76	26-5 1.88	27-7 2.15	29-3 2.56	
	16.0	18-3 0.83	18-11 0.92	19-6 1.01	20-1 1.11	20-8 1.21	21-3 1.31	21-10 1.41	22-4 1.52	22-10 1.63	23-11 1.86	25-4 2.22	26-8 2.60
	24.0	14-11 0.68	15-5 0.75	15-11 0.83	16-5 0.90	16-11 0.99	17-4 1.07	17-10 1.15	18-3 1.24	18-8 1.33	19-6 1.52	20-8 1.81	21-10 2.12

For SI: 1 inch = 25.4 mm, 1 pound per square inch = 6.895 kPa, 1 pound per square foot = 0.0479 kN/m2.

NOTE: The modulus of elasticity, "*E*," in 1,000,000 pounds per square inch is shown below each span.

TABLE 3608.2.4k
ALLOWABLE SPANS FOR LOW OR HIGH SLOPE RAFTERS
30 Lbs. per Sq. Ft. Live Load (Supporting Gypsum Ceiling)
For Use in Snow Load Zone 2

DESIGN CRITERIA: Strength—15 lbs. per sq. ft. dead load plus 30 lbs. per sq. ft. live load determines fiber stress. Deflection—For 30 lbs. per sq. ft. live load. Limited to span in inches divided by 240.

RAFTERS: Spans are measured along the horizontal projection and loads are considered as applied on the horizontal projection.

HOW TO USE TABLES: Enter table with span of rafters (upper figure in each square). Determine size and spacing (last column) based on stress grade (top row) and modulus of elasticity (lower figure in each square) of lumber to be used.

RAFTER SIZE AND SPACING		ALLOWABLE EXTREME FIBER STRESS IN BENDING, "*Fb*," (psi)										
(i nches)	**(i nches)**	**300**	**400**	**500**	**600**	**700**	**800**	**900**	**1000**	**1100**	**1200**	**1300**
2 x 6	12.0	5-10 0.13	6-8 0.19	7-6 0.27	8-2 0.36	8-10 0.45	9-6 0.55	10-0 0.66	10-7 0.77	11-1 0.89	11-7 1.01	12-1 1.14
	16.0	5-0 0.11	5-10 0.17	6-6 0.24	7-1 0.31	7-8 0.39	8-2 0.48	8-8 0.57	9-2 0.67	9-7 0.77	10-0 0.88	10-5 0.99
	24.0	4-1 0.09	4-9 0.14	5-4 0.19	5-10 0.25	6-3 0.32	6-8 0.39	7-1 0.46	7-6 0.54	7-10 0.63	8-2 0.72	8-6 0.81
2 x 8	12.0	7-8 0.13	8-10 0.19	9-10 0.27	10-10 0.36	11-8 0.45	12-6 0.55	13-3 0.66	13-11 0.77	14-8 0.89	15-3 1.01	15-11 1.14
	16.0	6-7 0.11	7-8 0.17	8-7 0.24	9-4 0.31	10-1 0.39	10-10 0.48	11-6 0.57	12-1 0.67	12-8 0.77	13-3 0.88	13-9 0.99
	24.0	5-5 0.09	6-3 0.14	7-0 0.19	7-8 0.25	8-3 0.32	8-10 0.39	9-4 0.46	9-10 0.54	10-4 0.63	10-10 0.72	11-3 0.81
2x 10	12.0	9 -9 0.13	11-3 0.19	12-7 0.27	13-9 0.36	14-11 0.45	15-11 0.55	16-11 0.66	17-10 0.77	18-8 0.89	19-6 1.01	20-4 1.14
	16.0	8-5 0.11	9-9 0.17	10-11 0.24	11-11 0.31	12-11 0.39	13-9 0.48	14-8 0.57	15-5 0.67	16-2 0.77	16-11 0.88	17-7 0.99
	24.0	6-11 0.09	8-0 0.14	8-11 0.19	9-9 0.25	10-6 0.32	11-3 0.39	11-11 0.46	12-7 0.54	13-2 0.63	13-9 0.72	14-4 0.81
2 x 12	12.0	11-10 0.13	13-8 0.19	15-4 0.27	16-9 0.36	18-1 0.45	19-4 0.55	20-6 0.66	21-8 0.77	22-8 0.89	23-9 1.01	24-8 1.14
	16.0	10-3 0.11	11-10 0.17	13-3 0.24	14-6 0.31	15-8 0.39	16-9 0.48	17-9 0.57	18-9 0.67	19-8 0.77	20-6 0.88	21-5 0.99
	24.0	8-5 0.09	9-8 0.14	10-10 0.19	11-10 0.25	12-10 0.32	13-8 0.39	14-6 0.46	15-4 0.54	16-1 0.63	16-9 0.72	17-5 0.81
(inches)	**(inches)**	**1 400**	**1500**	**1600**	**1700**	**1800**	**1900**	**2000**	**2100**	**2200**	**2400**	
2 x 6	12.0	12-6 1.28	13-0 1.41	13-5 1.56	13-10 1.71	14-2 1.86	14-7 2.02	15-0 2.18	15-4 2.34	15-8 2.51	16-5 2.86	
	16.0	10-10 1.10	11-3 1.22	11-7 1.35	11-11 1.48	12-4 1.61	12-8 1.75	13-0 1.89	13-3 2.03	13-7 2.18	14-2 2.48	
	24.0	8-10 0.90	9-2 1.00	9-6 1.10	9-9 1.21	10-0 1.31	10-4 1.43	10-7 1.54	10-10 1.66	11-1 1.78	11-7 2.02	12-4 2.41
2 x 8	12 0	16-6 1.28	17-1 1.41	17-8 1.56	18-2 1.71	18-9 1.86	19-3 2.02	19-9 2.18	20-3 2.34	20-8 2.51	21-7 2.86	
	16.0	14-4 1.10	14-10 1.22	15-3 1.35	15-9 1.48	16-3 1.61	16-8 1.75	17-1 1.89	17-6 2.03	17-11 2.18	18-9 2.48	
	24.0	11-8 0.90	12-1 1.00	12-6 1.10	12-10 1.21	13-3 1.31	13-7 1.43	13-11 1.54	14-4 1.66	14-8 1.78	15-3 2.02	16-3 2.41
2x 10	12 0	21-1 1.28	21-10 1.41	22-6 1.56	23-3 1.71	23-11 1.86	24-6 2.02	25-2 2.18	25-10 2.34	26-5 2.51	27-7 2.86	
	16.0	18-3 1.10	18-11 1.22	19-6 1.35	20-1 1.48	20-8 1.61	21-3 1.75	21-10 1.89	22-4 2.03	22-10 2.18	23-11 2.48	
	24.0	14-11 0.90	15-5 1.00	15-11 1.10	16-5 1.21	16-11 1.31	17-4 1.43	17-10 1.54	18-3 1.66	18-8 1.78	19-6 2.02	20-8 2.41
2 x 12	12 0	25-7 1.28	26-6 1.41	27-5 1.56	28-3 1.71	29-1 1.86	29-10 2.02	30-7 2.18	31-4 2.34	32-1 2.51	33-6 2.86	
	16.0	22-2 1.10	23-0 1.22	23-9 1.35	24-5 1.48	25-2 1.61	25-10 1.75	26-6 1.89	27-2 2.03	27-10 2.18	29-1 2.48	
	24.0	18-1 0.90	18-9 1.00	19-4 1.10	20-0 1.21	20-6 1.31	21-1 1.43	21-8 1.54	22-2 1.66	22-8 1.78	23-9 2.02	25-2 2.41

For SI: 1 inch = 25.4 mm, 1 pound per square inch = 6.895 kPa, 1 pound per square foot = 0.0479 kN/m2.

NOTE: The modulus of elasticity, "E," in 1,000,000 pounds per square inch is shown below each span.

TABLE 3608.2.4l
ALLOWABLE SPANS FOR LOW OR HIGH SLOPE RAFTERS
30 Lbs. per Sq. Ft. Live Load (Supporting Plaster Ceiling)
For Use in Snow Load Zone 2

DESIGN CRITERIA: Strength—15 lbs. per sq ft. dead load plus 30 Ibs. per sq.ft. live load determines fiber stress. Deflection—For 30 Ibs. per sq. ft. live load. Limited to span in inches divided by 360.

RAFTERS: Spans are measured along the horizontal projection and loads are considered as applied on the horizontal projection.

HOW TO USE TABLES: Enter table with span of rafters (upper figure in each square). Determine size and spacing (first column) based on stress grade (top row) and modulus of elasticity (lower figure in each square) of lumber to be used.

RAFTER SIZE AND SPACING		ALLOWABLE EXTREME FIBER STRESS IN BENDING, "*Fb*," (psi)									
(inches)	**(inches)**	**300**	**400**	**500**	**600**	**700**	**800**	**900**	**1000**	**1100**	**1200**
2 x 6	12.0	5-10 0.19	6-8 0.29	7-6 0.41	8-2 0.54	8-10 0.68	9-6 0.83	10-0 0.99	10-7 1.15	11-1 1.33	11-7 1.52
	16.0	5-0 0.16	5-10 0.25	6-6 0.35	7-1 0.46	7-8 0.59	8-2 0.72	8-8 0.85	9-2 1.00	9-7 1.15	10-0 1.31
	24.0	4-1 0.13	4-9 0.21	5-4 0.29	5-10 0.38	6-3 0.48	6-8 0.58	7-1 0.70	7-6 0.82	7-10 0.94	8-2 1.07
2 x 8	12.0	7-8 0.19	8-10 0.29	9-10 0.41	10-10 0.54	11-8 0.68	12-6 0.83	13-3 0.99	13-11 1.15	14-8 1.33	15-3 1.52
	16.0	6-7 0.16	7-8 0.25	8-7 0.35	9-4 0.46	10-1 0.59	10-10 0.72	11-6 0.85	12-1 1.00	12-8 1.15	13-3 1.31
	24. 0	5-5 0.13	6-3 0.21	7-0 0.29	7-8 0.38	8-3 0.48	8-10 0.58	9-4 0.70	9-10 0.82	10-4 0.94	10-10 1.07
2 x 10	12.0	9-9 0.19	11-3 0.29	12-7 0.41	13-9 0.54	14-11 0.68	15-11 0.83	16-11 0.99	17-10 1.15	18-8 1.33	19-6 1.52
	16.0	8-5 0.16	9-9 0.25	10-11 0.35	11-11 0.46	12-11 0.59	13-9 0.72	14-8 0.85	15-5 1.00	16-2 1.15	16-11 1.31
	24.0	6-11 0.13	8-0 0.21	8-11 0.29	9 9 0.38	10-6 0.48	11-3 0.58	11-11 0.70	12-7 0.82	13-2 0.94	13-9 1.07
2x 12	12.0	11-10 0.19	13-8 0.29	15-4 0.41	16-9 0.54	18-1 0.68	19-4 0.83	20-6 0.99	21-8 1.15	22-8 1.33	23-9 1.52
	16.0	10-3 0.16	11-10 0.25	13-3 0.35	14-6 0.46	15-8 0.59	16-9 0.72	17-9 0.85	18-9 1.00	19-8 1.15	20-6 1.31
	24.0	8-5 0.13	9-8 0.21	10-10 0.29	11-10 0.38	12-10 0.48	13-8 0.58	14-6 0.70	15-4 0.82	16-1 0.94	16-9 1.07
(inches)	**(inches)**	**1300**	**1400**	**1500**	**1600**	**1700**	**1800**	**1900**	**2000**	**2100**	**2200**
2 x 6	12. 0	12-1 1.71	12-6 1.91	13-0 2.12	13-5 2.34	13-10 2.56	14-1 2.79	14-6 3.02	15-0 3.27	15-4 3.51	15-8 3.77
	16.0	10-5 1.48	10-10 1.66	11-3 1.84	11-7 2.02	11-11 2.22	12-4 2.41	12-8 2.62	12-11 2.82	13-3 3.04	13-11 3.26
	24.0	8-6 1.21	8-10 1.35	9-2 1.50	9-6 1.65	9-9 1.81	10-0 1.97	10-4 2.14	10-7 2.31	10-10 2.48	11-1 2.66
2 x 8	12.0	15-11 1.71	16-6 1.91	17-1 2.12	17-8 2 34	18-2 2.56	18-8 2.79	19-3 3.02	19-9 3.27	20-3 3.51	20-8 3.77
	16.0	13-9 1.48	14-4 1.66	14-10 1.84	15-3 2.02	15-9 2.22	16-3 2.41	16-8 2.62	17-1 2.83	17-6 3.04	17-11 3.26
	24.0	11-3 1.21	11-8 1.35	12-1 1.50	12-6 1.65	12-10 1.81	13-3 1.97	13-7 2.14	13-11 2.31	14-4 2.48	14-7 2.66
2 x 10	12.0	20-4 1.71	21-1 1.91	21-10 2.12	22-6 2.34	23-3 2.56	23-10 2.79	24-6 3.02	25-2 3.27	25-10 3.51	26-5 3.77
	16.0	17-7 1.48	18-3 1.66	18-11 1.84	19-6 2.02	20-1 2.22	20-8 2.41	21-3 2.62	21-9 2.83	22-4 3.04	22-10 3.26
	24.0	14-4 1.21	14-11 1.35	15-5 1.50	15-11 1.65	16-5 1.81	16-11 1.97	17-4 2.14	17-10 2.31	18-3 2.48	18-8 2.66
2x 12	12.0	24-8 1.71	25-7 1.91	26-6 2.12	27-5 2.34	28-3 2.56	29-1 2.79	29-10 3.02	30-7 3.27	21-4 3.51	32-1 3.77
	16.0	21-5 1.48	22-2 1.66	23-0 1.84	23-9 2.02	24-5 2.22	25-2 2.41	25-10 2.62	26-6 2.83	27-2 3.04	27-10 3.26
	24.0	17-5 1.21	18-1 1.35	18-9 1.50	19-4 1.65	20-0 1.81	20-6 1.97	21-1 2.14	21-8 2.31	22-2 2.48	22-8 2.66

For SI: 1 inch = 25,4 mm, 1 pound per square inch = 6.895 kPa, 1 pound per square foot = 0.0479 kN/m2.

NOTE: The modulus of elasticity, "E," in 1,000,000 pounds per square inch is shown below each span.

TABLE 3608.2.4m
ALLOWABLE SPANS FOR LOW OR HIGH SLOPE RAFTERS

35 Lbs. per Sq. Ft. Live Load

For Use in Snow Load Zone 3

DESIGN CRITERIA: Strength-35 lbs. per sq. ft. live load plus 10 lbs. per sq. ft. dead load determines fiber stress. Deflection—For 35 lbs. per sq. ft. live load. Limited to span in inches divided by 180.

RAFTERS: Spans are measured along the horizontal projection and loads are considered as applied on the horizontal projection.

HOW TO USE TABLES: Enter table with span of rafters (upper figure in each square). Determine size and spacing (first column) based on stress grade (top row) and modulus of elasticity (lower figure in each square) of lumber to be used.

RAFTER SIZE AND SPACING		**ALLOWABLE EXTREME FIBER STRESS IN BENDING, "*Fb*," (psi)**									
(inches)	**(inches)**	**300**	**400**	**500**	**600**	**700**	**800**	**900**	**1000**	**1100**	**1200**
2 x 6	12.0	5-10 .11	6-8 .17	7-6 .24	8-2 .31	8-10 .39	9-6 .48	10-0 .58	10-7 .67	11-1 .78	11-7 .89
	16.0	5-0 .10	5-10 .15	6-6 .21	7-1 .27	7-8 .34	8-2 .42	8-8 .50	9-2 .58	9-7 .67	10-0 .77
	24.0	4-1 .08	4-9 .12	5-4 .17	5-10 .22	6-3 .28	6-8 .34	7-1 .41	7-6 .48	7-10 .55	8-2 .63
2 x 8	12.0	7-8 .11	8-10 .17	9-10 .24	10-10 .31	11-8 .39	12-6 .48	13-3 .58	13-11 .67	14-8 .78	15-3 .89
	16.0	6-7 .10	7-8 .15	8-7 .21	9-4 .27	10-1 .34	10-10 .42	11-6 .50	12-1 .58	12-8 .67	13-3 .77
	24. 0	5-5 .08	6-3 .12	7-0 .17	7-8 .22	8-3 .28	8-10 .34	9-4 .41	9-10 .48	10-4 .55	10-10 .63
2 x 10	12.0	9-9 .11	11-3 .17	12-7 .24	13-9 .31	14-11 .39	15-11 .48	16-11 .58	17-10 .67	18-8 .78	19-6 .89
	16.0	8-5 .10	9-9 .15	10-11 .21	11-11 .27	12-11 .34	13-9 .42	14-8 .50	15-5 .58	16-2 .67	16-11 .77
	24.0	6-11 .08	8-0 .12	8-11 .17	9-9 .22	10-6 .28	11-3 .34	11-11 .41	12-7 .48	13-2 .55	13-9 .63
2x 12	12.0	11-10 0.11	13-8 0.17	15-4 0.24	16-9 0.31	18-1 0.39	19-4 0.48	20-6 0.58	21-8 0.67	22-9 0.78	23-9 0.89
	16.0	10-3 0.10	11-10 0.15	13-3 0.21	14-6 0.27	15-8 0.34	16-9 0.42	17-8 0.58	18-9 0.58	19-8 0.67	20-6 0.77
	24.0	8-4 0.08	9-8 0.12	10-10 0.17	11.10 0.22	12-10 0.28	13-8 0.34	14-6 0.41	15-4 0.48	16-1 0.55	16-9 0.63
(inches)	**(inches)**	**1300**	**1400**	**1500**	**1600**	**1700**	**1800**	**1900**	**2000**	**2100**	**2200**
2 x 6	12. 0	12-1 1.00	12-6 1.12	13-0 1.24	13-5 1.36	13-10 1.49	14-2 1.63	14-7 1.76	15-0 1.91	15-4 2.05	15-9 2.2
	16.0	10-5 .86	10-10 .97	11-3 1.07	11-7 1.18	11-11 1.29	12-4 1.41	12-8 1.53	13-0 1.65	13-3 1.78	13-7 1.90
	24.0	8-6 .71	8-10 .79	9-2 .88	9-6 .96	9-9 1.06	10-0 1.15	10-4 1.25	10-7 1.35	10-10 1.45	11-1 1.55
2 x 8	12.0	15-11 1.00	16-6 1.12	17-1 1.24	17-8 1.36	18-2 1.49	18-9 1.63	19-3 1.76	19-9 1.91	20-3 2.05	20-8 2.20
	16.0	13-9 .86	14-4 .97	14-10 1.07	15-3 1.18	15-9 1.29	16-3 1.41	16-8 1.53	17-1 1.65	17-6 1.78	17-11 1.90
	24.0	11-3 .71	11-8 .79	12-1 .88	12-6 .96	12-10 1.06	13-3 1.15	13-7 1.25	13-11 1.35	14-4 1.45	14-8 1.55
2 x 10	12.0	20-4 1.00	21-1 1.12	21-10 1.24	22-6 1.36	23-3 1.49	23-11 1.63	24-6 1.76	25-2 1.91	25-10 2.05	26-5 2.20
	16.0	17-7 .86	18-3 .97	18-11 1.07	19-6 1.18	20-1 1.29	20-8 1.41	21-3 1.53	21-10 1.65	22-4 1.78	22-10 1.90
	24.0	14-4 .71	14-11 .79	15-5 .88	15-11 .96	16-5 1.06	16-11 1.15	17-4 1.25	17-10 1.35	18-3 1.45	18-8 1.55
2x 12	12.0	24-8 1.00	25-7 22-2	26-6 1.24	27-4 1.36	28-3 1.49	29-1 1.63	29-10 1.76	30-7 1.91	31-4 2.05	21-1 2.20
	16.0	21-4 0.86	0.97 18-1	22-11 1.07	23-9 1.18	24-5 1.29	25-2 1.41	25-10 1.53	26-6 1.65	27-2 1.78	27-10 1.90
	24.0	17-5 0.71	0.79 0.79	18-9 0.87	19-4 0.96	19-11 1.06	20-6 1.15	21-2 1.25	21-8 1.35	22.2 1.45	22-9 1.55

For Sl: 1 inch = 25,4 mm, 1 pound per square inch = 6.895 kPa, 1 pound per square foot = 0.0479 kN/m2.

NOTE: The modulus of elasticity, "E," in 1,000,000 pounds per square inch is shown below each span.

TABLE 36082.4n

ALLOWABLE SPANS FOR LOW OR HIGH SLOPE RAFTERS

35 Lbs. per Sq. Ft. Live Load (Supporting Gypsum Wallboard Ceiling)

For Use in Snow Load Zone 3

DESIGN CRITERIA: Strength-35 lbs. per sq. ft. live load plus 10 lbs. per sq. ft. dead load determines fiber stress. Deflection—For 35 lbs. per sq. ft. live load. Limited to span in inches divided by 240.

RAFTERS: Spans are measured along the horizontal projection and loads are considered as applied on the horizontal projection.

HOW TO USE TABLES: Enter table with span of rafters (upper figure in each square). Determine size and spacing (first column) based on stress grade (top row) and modulus of elasticity (lower figure in each square) of lumber to be used.

RAFTER SIZE AND SPACING		ALLOWABLE EXTREME FIBER STRESS IN BENDING, "*Fb*," (psi)									
(inches)	**(inches)**	**300**	**400**	**500**	**600**	**700**	**800**	**900**	**1000**	**1100**	**1200**
2 x 6	12.0	5-10 0.15	6-8 0.23	7-6 .32	8-2 .42	8-10 .53	9-6 .64	10-0 .77	10-7 .90	11-1 1.04	11-7 1.18
	16.0	5-0 .13	5-10 .20	6-6 .27	7-1 .36	7-8 .46	8-2 .56	8-8 .66	9-2 .78	9-7 .90	10-0 1.02
	24.0	4-1 .10	4-9 .16	5-4 .22	5-10 .30	6-3 .37	6-8 .45	7-1 .54	7-6 .64	7-10 .73	8-2 .83
2 x 8	12.0	7-8 .15	8-10 .23	9-10 .32	10-10 .42	11-8 .53	12-6 .64	13-3 .77	13-11 .90	14-8 1.04	15-3 1.18
	16.0	6-7 .13	7-8 .20	8-7 .27	9-4 .36	10-1 .46	10-10 .56	11-6 .66	12-1 .78	12-8 .90	13-3 1.02
	24. 0	5-5 .10	6-3 .16	7-0 .22	7-8 .30	8-3 .37	8-10 .45	9-4 .54	9-10 .64	10-4 .73	10-10 .83
2 x 10	12.0	9-9 .15	11-3 .23	12-7 .32	13-9 .42	14-11 .53	15-11 .64	16-11 .77	17-10 .90	18-8 1.04	19-6 1.18
	16.0	8-5 .13	9-9 .20	10-11 .27	11-11 .36	12-11 .46	13-9 .56	14-8 .66	15-5 .78	16-2 .90	16-11 1.02
	24.0	6-11 .10	8-0 .16	8-11 .22	9-9 .20	10-6 .37	11-3 .45	11-11 .54	12-7 .64	13-2 .73	13-9 .83
2x 12	12.0	11-10 .15	13-8 .23	15-4 .32	16-9 .42	18-1 .53	19-4 .64	20-6 .77	21-8 .90	22-8 1.04	23-9 1.18
	16.0	10-3 .13	11-10 .20	13-3 .27	14-6 .36	15-8 .46	16-9 .56	17-9 .66	18-9 .78	19-8 .90	20-6 1.02
	24.0	8-5 .10	9-8 .16	10-10 .22	11-10 .30	12-10 .37	13-8 .45	14-6 .54	15-4 .64	16-1 .73	16-9 .83
(inches)	**(inches)**	**1300**	**1400**	**1500**	**1600**	**1700**	**1800**	**1900**	**2000**	**2100**	**2200**
2 x 6	12. 0	12-1 1.33	12-6 1.49	13-0 1.65	13-5 1.82	13-10 1.99	14-2 2.17	14-7 2.35	15-0 2.54	15-4 2.74	15-8 2.93
	16.0	10-5 1.15	10-10 1.29	11-3 1.43	11-7 1.57	11-11 1.72	12-4 1.88	12-8 2.04	13-0 2.20	13-3 2.37	13-7 2.54
	24.0	8-6 .94	8-10 1.05	9-2 1.17	9-6 1.29	9-9 1.41	10-0 1.53	10-4 1.66	10-7 1.80	10-10 1.93	11-1 2.07
2 x 8	12.0	15-11 1.33	16-6 1.49	17-1 1.65	17-8 1.82	18-2 1.99	18-9 2.17	19-3 2.35	19-9 2.54	20-3 2.74	20-8 2.93
	16.0	13-9 1.15	14-4 1.29	14-10 1.43	15-3 1.57	15-9 1.72	16-3 1.88	16-8 2.04	17-1 2.20	17-6 2.37	17-11 2.54
	24.0	11-3 .94	11-8 1.05	12-1 1.17	12-6 1.29	12-10 1.41	13-3 1.53	13-7 1.66	13-11 1.80	14-4 1.93	14-7 2.07
2 x 10	12.0	20-4 1.33	21-1 1.49	21-10 1.65	22-6 1.82	23-3 1.99	23-11 2.17	24-6 2.35	25-2 2.54	25-10 2.74	26-5 2.93
	16.0	17-7 1.15	18-3 1.29	18-11 1.43	19-6 1.57	20-1 1.72	20-8 1.88	21-3 2.04	21-10 2.20	22-4 2.37	22-10 2.54
	24.0	14-4 .94	14-11 1.05	15-5 1.17	15-11 1.29	16-5 1.41	16-11 1.53	17-4 1.66	17-10 1.80	18-3 1.93	18-8 2.07
2x 12	12.0	24-8 1.33	25-7 1.49	26-6 1.65	27-4 1.82	28-3 1.99	29-0 2.17	29-10 2.35	30-7 2.54	31-4 2.74	32-1 2.93
	16.0	21-5 1.15	22-2 1.29	23-0 1.43	23-9 1.57	24-5 1.72	25-2 1.88	25-10 2.04	26-5 2.20	27-2 2.37	27-10 2.54
	24.0	17-5 .94	18-1 1.05	18-9 1.17	19-4 1.29	20-0 1.41	20-6 1.53	21-1 1.66	21-8 1.80	22-2 1.93	22-8 2.07

For SI: 1 inch = 25,4 mm, 1 pound per square inch = 6.895 kPa, 1 pound per square foot = 0.0479 kN/m2.

NOTE: The modulus of elasticity, "E," in 1,000,000 pounds per square inch is shown below each span.

TABLE 3608.2.4o
ALLOWABLE SPANS FOR LOW OR HIGH SLOPE RAFTERS
35 Lbs. per Sq. Ft. Live Load (Supporting Veneer Plaster Ceiling)
For Use in Snow Load Zone 3

DESIGN CRITERIA: Strength-35 lbs. per sq. ft. live load plus 10 lbs. per sq. ft. dead load determines fiber stress. Deflection—For 35 lbs. per sq. ft. live load. Limited to span in inches divided by 360.

RAFTERS: Spans are measured along the horizontal projection and loads are considered as applied on the horizontal projection.

HOW TO USE TABLES: Enter table with span of rafters (upper figure in each square). Determine size and spacing (first column) based on stress grade (top row) and modulus of elasticity (lower figure in each square) of lumber to be used.

RAFTER SIZE AND SPACING		ALLOWABLE EXTREME FIBER STRESS IN BENDING, "*Fb*," (psi)									
(inches)	**(inches)**	**300**	**400**	**500**	**600**	**700**	**800**	**900**	**1000**	**1100**	**1200**
2 x 6	12.0	5-10 .22	6-8 .34	7-6 .48	8-2 .63	8-10 .79	9-6 .96	10-0 1.15	10-7 1.35	11-1 1.55	11-7 1.77
	16.0	5-0 .19	5-10 .30	6-6 .41	7-1 .54	7-8 .68	8-2 .83	8-8 1.00	9-2 1.17	9-7 1.35	10-0 1.53
	24.0	4-1 .16	4-9 .24	5-4 .34	5-10 .44	6-3 .56	6-8 .68	7-1 .81	7-6 .95	7-10 1.10	8-2 1.25
2 x 8	12.0	7-8 .22	8-10 .34	9-10 .48	10-10 .63	11-8 .79	12-6 .96	13-3 1.15	13-11 1.35	14-8 1.55	15-3 1.77
	16.0	6-7 .19	7-8 .30	8-7 .41	9-4 .54	10-1 .68	10-10 .83	11-6 1.00	12-1 1.17	12-8 1.35	13-3 1.53
	24. 0	5-5 .16	6-3 .24	7-0 .34	7-8 .44	8-3 .56	8-10 .68	9-4 .81	9-10 .95	10-4 1.10	10-10 1.25
2 x 10	12.0	9-9 .22	11-3 .34	12-7 .48	13-9 .63	14-11 .79	15-11 .96	16-11 1.15	17-10 1.35	18-8 1.55	19-6 1.77
	16.0	8-5 .19	9-9 .30	10-11 .41	11-11 .54	12-11 .68	13-9 .83	14-8 1.00	15-5 1.17	16-2 1.35	16-11 1.53
	24.0	6-11 .16	8-0 .24	8-11 .34	9-9 .44	10-6 .56	11-3 .68	11-11 .81	12-7 .95	13-2 1.10	13-9 1.25
2x 12	12.0	11-10 .22	13-8 .34	15-4 .48	16-9 .63	18-1 .79	19-4 .96	20-6 1.15	21-8 1.35	22-8 1.55	23-9 1.77
	16.0	10-3 .19	11-10 .30	13-3 .41	14-6 .54	15-8 .68	16-9 .83	17-9 1.00	18-9 1.17	19-8 1.35	20-6 1.53
	24.0	8-5 .16	9-8 .24	10-10 .34	11-10 .44	12-10 .56	13-8 .68	14-6 .81	15-4 .95	16-1 1.10	16-9 1.25
(inches)	**(inches)**	**1300**	**1400**	**1500**	**1600**	**1700**	**1800**	**1900**	**2000**	**2100**	**2200**
2 x 6	12. 0	12-1 2.00	12-6 2.23	13-0 2.47	13-4 2.73	13-10 2.99	14-2 3.26	14-7 3.53	14-11 3.81	15-4 4.10	15-8 4.40
	16.0	10-5 1.73	10-10 1.93	11-3 2.14	11-7 2.36	11-11 2.59	12-4 2.82	12-7 3.06	12-11 3.30	13-3 3.55	13-7 3.81
	24.0	8-6 1.41	8-10 1.58	9-2 1.75	9-6 1.93	9-9 2.11	10-0 2.30	10-4 2.49	10-7 2.69	10-10 2.90	11-1 3.11
2 x 8	12.0	15-11 2.00	16-6 2.23	17-1 2.47	17-8 2.73	18-2 2.99	18-9 3.26	19-3 3.53	19-9 3.81	20-3 4.10	20-8 4.40
	16.0	13-9 1.73	14-4 1.93	14-10 2.14	15-3 2.36	15-9 2.59	16-3 2.82	16-8 3.06	17-1 3.30	17-6 3.55	17-11 3.81
	24.0	11-3 1.41	11-8 1.58	12-1 1.75	12-6 1.93	12-10 2.11	13-3 2.30	13-7 2.49	13-11 2.69	14-4 2.90	14-8 3.11
2 x 10	12.0	20-4 2.00	21-1 2.23	21-10 2.47	22-6 2.73	23-3 2.99	23-10 3.26	24-6 3.53	25-2 3.81	25-9 4.10	26-5 4.40
	16.0	17-7 1.73	18-3 1.93	18-11 2.14	19-6 2.36	20-1 2.59	20-8 2.82	21-3 3.06	21-9 3.30	22-4 3.55	22-10 3.81
	24.0	14-4 1.41	14-11 1.58	15-5 1.75	15-11 1.93	16-5 2.11	16-11 2.30	17-4 2.49	17-9 2.69	18-3 2.90	18-8 3.11
2x 12	12.0	24-8 2.00	25-7 2.23	26-6 2.47	27-4 2.73	28-3 2.99	29-0 3.26	29-10 3.53	30-7 3.81	31-4 4.10	21-1 4.40
	16.0	21-5 1.73	22-2 1.93	23-0 2.14	23-9 2.36	24-5 2.59	25-2 2.82	25-10 3.06	26-6 3.30	27-2 3.55	27-10 3.81
	24.0	17-5 1.41	18-1 1.58	18-9 1.75	19-4 193	20-0 2.11	20-6 2.30	21-1 2.49	21-8 2.69	22-2 2.90	22-9 3.11

For SI: 1 inch = 25,4 mm, 1 pound per square inch = 6.895 kPa, 1 pound per square foot = 0.0479 kN/m2.

NOTE: The modulus of elasticity, "E," in 1,000,000 pounds per square inch is shown below each span.

TABLE 36082.4p
ALLOWABLE SPANS FOR LOW OR HIGH SLOPE RAFTERS

35 Lbs. per Sq. Ft. Live Load

For Use in Snow Load Zone 3

DESIGN CRITERIA: Strength-35 Ibs. per sq. ft. live load plus 15 Ibs. per sq. ft. dead load determines fiber stress. Deflection—For 35 Ibs. per sq. ft. live load. Limited to span in inches divided by 180.

RAFTERS: Spans are measured along the horizontal projection and loads are considered as applied on the horizontal projection.

HOW TO USE TABLES: Enter table with span of rafters (upper figure in each square). Determine size and spacing (first column) based on stress grade (top row) and modulus of elasticity (lower figure in each square) of lumber to be used.

RAFTER SIZE AND SPACING		**ALLOWABLE EXTREME FIBER STRESS IN BENDING, "*Fb*," (psi)**									
(inches)	**(inches)**	**300**	**400**	**500**	**600**	**700**	**800**	**900**	**1000**	**1100**	**1200**
2 x 6	12.0	5-6 .09	6-4 .15	7-1 .20	7-9 .27	8-5 .34	9-0 .41	9-6 .49	10-0 .58	10-6 .66	11-0 .76
	16.0	4-9 .08	5-6 .13	6-2 .18	6-9 .23	7-3 .29	7-9 .36	8-3 .43	8-8 .50	9-1 .57	9-6 .65
	24.0	3-11 .07	4-6 .10	5-0 .14	5-6 .19	5-11 .24	6-4 .29	6-9 .35	7-1 .41	7-5 .47	7-9 .53
2 x 8	12.0	7-3 .09	8-4 .15	9-4 .20	10-3 .27	11-1 .34	11-10 .41	12-7 .49	13-3 .58	13-11 .66	14-6 .76
	16.0	6-3 .08	7-3 .13	8-1 .18	8-11 .23	9-7 .29	10-3 .36	10-10 .43	11-6 .50	12-0 .57	12-7 .65
	24. 0	5-2 .07	5-11 .10	6-7 .14	7-3 .19	7-10 .24	8-4 .29	8-1 .35	9-4 .41	9-10 .47	10-3 .53
2 x 10	12.0	9-3 .09	10-8 .15	11-11 .20	13-1 .27	14-2 .34	15-1 .41	16-0 .49	16-11 .58	17-9 .66	18-6 .76
	16.0	8-0 .08	9-3 .13	10-4 .18	11-4 .23	12-3 .29	13-1 .36	13-10 .43	14-8 .50	15-4 .57	16-0 .65
	24.0	6-6 .07	7-7 .10	8-5 .14	9-3 .19	10-0 .24	10-8 .29	11-4 .35	11-11 .41	12-6 .47	13-1 .53
2x 12	12.0	11-3 0.09	13-0 0.15	14-6 0.20	15-11 0.27	17-2 0.34	18-4 0.41	19-6 0.49	20.6 0.58	21-6 0.66	22-6 0.76
	16.0	9-9 0.08	11-3 0.13	12-7 0.18	13-9 0.23	14-10 0.29	15-11 0.36	16-10 0.43	17-9 0.50	18-8 0.57	19-6 0.65
	24.0	8-0 0.07	9-2 0.10	10-3 0.14	11-3 0.19	12-2 0.24	13-0 0.29	13-8 0.35	14-6 0.41	15-3 0.47	15-11 0.53
(inches)	**(inches)**	**1300**	**1400**	**1500**	**1600**	**1700**	**1800**	**1900**	**2000**	**2100**	**2200**
2 x 6	12. 0	11-5 .85	11-11 .95	12-4 1.06	12-8 1.16	13-1 1.27	13-6 1.39	13-10 1.51	14-2 1.63	14-7 1.75	14-10 1.88
	16.0	9-11 .74	10-3 .83	10-8 .91	11-0 1.01	11-4 1.10	11-8 1.20	12-0 1.30	12-4 1.41	12-7 1.52	12-10 1.62
	24.0	8-1 .60	8-5 .67	8-8 .75	9-0 .82	9-3 .90	9-6 .98	9-9 1.07	10-0 1.15	10-3 1.24	10-6 1.33
2 x 8	12.0	15-1 .85	15-8 .95	16-3 1.06	16-9 1.16	17-3 1.27	17-9 1.39	18-3 1.51	18-9 1.63	19-2 1.75	19-7 1.88
	16.0	13-1 .74	13-7 .83	14-0 .91	14-6 1.01	14-11 1.10	15-5 1.20	15-10 1.30	16-3 1.41	16-7 1.52	17-0 1.62
	24.0	10-8 .60	11-1 .67	11-6 .75	11-10 .82	12-2 .90	12-7 .98	12-11 1.07	13-3 1.15	13-7 1.24	13-10 1.33
2 x 10	12.0	19-3 .85	20-0 .95	20-8 1.06	21-4 1.16	22-0 1.27	22-8 1.39	23-3 1.51	23-11 1.63	24-6 1.75	25-0 1.88
	16.0	16-8 .74	17-4 .83	17-11 .91	18-6 1.01	19-1 1.10	19-7 1.20	20-2 1.30	20-8 1.41	21-2 1.52	21-8 1.62
	24.0	13-7 .60	14-2 .67	14-8 .75	15-1 .82	15-7 .90	16-0 .98	16-6 1.07	16-11 1.15	17-4 1.24	17-9 1.33
2x 12	12.0	23-5 0.85	24-3 0.95	25-2 1.06	21-4 1.16	26-9 1.27	27-6 1.39	28-4 1.51	29-0 1.63	29-9 1.75	30-5 1.88
	16.0	20-3 0.74	21-0 0.82	21-9 0.91	22-6 1.01	23-2 1.10	23-10 1.20	24-6 1.30	25-2 1.41	25-9 1.51	26-4 1.62
	24.0	16-6 0.60	17-2 0.67	17-9 0.75	18-4 0.82	18-11 0.90	19-6 0.98	20-0 1.07	20-6 1.15	21-0 1.24	21-7 1.33

For SI: 1 inch = 25,4 mm, 1 pound per square inch = 6.895 kPa, 1 pound per square foot = 0.0479 kN/m2.

NOTE: The modulus of elasticity, "E," in 1,000,000 pounds per square inch is shown below each span.

TABLE 3608.2.4q

ALLOWABLE SPANS FOR LOW OR HIGH SLOPE RAFTERS

35 Lbs. per Sq. Ft. Live Load (Supporting Gypsum Wallboard Ceiling)

For Use in Snow Load Zone 3

DESIGN CRITERIA: Strength-35 Ibs. per sq.ft. live load plus 15 Ibs. per sq.ft. dead load determines fiber stress. Deflection—For 35 Ibs. per sq. ft. live load. Limited to span in inches divided by 240.

RAFTERS: Spans are measured along the horizontal projection and loads are considered as applied on the horizontal projection.

HOW TO USE TABLES: Enter table with span of rafters (upper figure in each square). Determine size and spacing (first column) based on stress grade (top row) and modulus of elasticity (lower figure in each square) of lumber to be used.

RAFTER SIZE AND SPACING		**ALLOWABLE EXTREME FIBER STRESS IN BENDING, "*Fb*," (psi)**									
(inches)	**(inches)**	**300**	**400**	**500**	**600**	**700**	**800**	**900**	**1000**	**1100**	**1200**
2 x 6	12.0	5-6 .13	6-4 .19	7-1 .27	7-9 .36	8-5 .45	9-0 .55	9-6 .65	10-0 .77	10-6 .88	11-0 1.01
	16.0	4-9 .11	5-6 .17	6-2 .23	6-9 .31	7-3 .39	7-9 .48	8-3 .57	8-8 .66	9-1 .77	9-6 .87
	24.0	3-11 .09	4-6 .14	5-0 .19	5-6 .25	5-11 .32	6-4 .39	6-9 .46	7-1 .54	7-5 .63	7-9 .71
2 x 8	12.0	7-3 .13	8-4 .19	9-4 .27	10-3 .36	11-1 .45	11-10 .55	12-7 .65	13-3 .77	13-11 .88	14-6 1.01
	16.0	6-3 .11	7-3 .17	8-1 .23	8-11 .31	9-7 .39	10-3 .48	10-10 .57	11-6 .66	12-0 .77	12-7 .87
	24. 0	5-2 .09	5-11 .14	6-7 .19	7-3 .25	7-10 .32	8-4 .39	8-11 .46	9-4 .54	9-10 .63	10-3 .71
2 x 10	12.0	9-3 .13	10-8 .19	11-11 .27	13-1 .36	14-2 .45	15-1 .55	16-0 .65	16-11 .77	17-9 .88	18-6 1.01
	16.0	8-0 .11	9-3 .17	10-4 .23	11-4 .31	12-3 .39	13-1 .48	13-10 .57	14-8 .66	15-4 .77	16-0 .87
	24.0	6-6 .09	7-7 .14	8-5 .19	9-3 .25	10-0 .32	10-8 .39	11-4 .46	11-11 .54	12-6 .63	13-1 .71
2x 12	12.0	11-3 .13	13-0 .19	14-6 .23	15-11 .36	17-2 .45	18-4 .55	19-6 .65	20-6 .77	21-7 .88	22-6 1.01
	16.0	9-9 .11	11-3 .17	12-7 .23	13-9 .31	14-11 .39	15-11 .48	16-10 .57	17-9 .66	18-8 .77	19-6 .87
	24.0	7-11 .09	9-2 .14	10-3 .19	11-3 .25	12-2 .32	13-0 .39	13-9 .46	14-6 .54	15-3 .63	15-11 .71
(inches)	**(inches)**	**1300**	**1400**	**1500**	**1600**	**1700**	**1800**	**1900**	**2000**	**2100**	**2200**
2 x 6	12. 0	11-5 1.14	11-11 1.27	12-4 1.41	12-8 1.55	13-1 1.70	13-6 1.85	13-10 2.01	14-2 2.17	14-7 2.33	14-10 2.50
	16.0	9-11 .98	10-3 1.10	10-8 1.22	11-0 1.34	11-4 1.47	11-8 1.60	12-0 1.74	12-4 1.88	12-7 2.02	12-10 2.16
	24.0	8-1 .80	8-5 .90	8-8 1.00	9-0 1.10	9-3 1.20	9-6 1.31	9-9 1.42	10-0 1.53	10-3 1.65	10-6 1.77
2 x 8	12.0	15-1 1.14	15-8 1.27	16-3 1.41	16-9 1.55	17-3 1.70	17-9 1.85	18-3 2.01	18-9 2.17	19-2 2.33	19-7 2.50
	16.0	13-1 .98	13-7 1.10	14-0 1.22	14-6 1.34	14-11 1.47	15-5 1.60	15-10 1.74	16-3 1.88	16-7 2.02	17-0 2.17
	24.0	10-8 .80	11-1 .90	11-6 1.00	11-10 1.10	12-2 1.20	12-7 1.31	12-11 1.42	13-3 1.53	13-7 1.65	13-10 1.77
2 x 10	12.0	19-3 1.14	20-0 1.27	20-8 1.41	21-4 1.55	22-8 1.70	22-8 1.85	23-3 2.01	23-11 2.17	24-6 2.33	25-0 2.50
	16.0	16-8 .98	17-4 1.10	17-11 1.22	18-6 1.34	19-1 1.47	19-7 1.60	20-2 1.74	20-8 1.88	21-2 2.02	21-8 2.16
	24.0	13-7 .80	14-2 .90	14-8 1.00	15-1 1.10	15-7 1.20	16-0 1.31	16-6 1.42	16-11 1.53	17-4 1.65	17-9 1.77
2x 12	12.0	23-5 1.14	24-4 1.27	25-2 1.41	26-0 1.55	26-9 1.70	27-6 1.85	28-4 2.01	29-0 2.17	29-9 2.33	30-5 2.50
	16.0	20-3 .98	21-1 1.10	21-9 1.22	22-6 1.34	23-2 1.47	23-10 1.60	24-6 1.74	25-2 1.88	25-9 2.02	26-4 2.16
	24.0	16-7 .80	17-2 .90	17-9 1.00	18-4 1.10	18-11 1.20	19-6 1.31	20-0 1.42	20-6 1.53	21-1 1.65	21-6 1.77

For SI: 1 inch = 25,4 mm, 1 pound per square inch = 6.895 kPa, 1 pound per square foot = 0.0479 kN/m2.

NOTE: The modulus of elasticity, "E," in 1,000,000 pounds per square inch is shown below each span.

TABLE 3608.2.4r

ALLOWABLE SPANS FOR LOW OR HIGH SLOPE RAFTERS

35 Lbs. per Sq. Ft. Live Load (Supporting Veneer Plaster Ceiling)

For Use in Snow Load Zone 3

DESIGN CRITERIA: Strength-35 Ibs. per sq. ft. live load plus 15 Ibs. per sq. ft.dead load determines fiber stress. Deflection—For 35 Ibs. per sq. ft. Iive load. Limited to span in inches divided by 360.

RAFTERS: Spans are measured along the horizontal projection and loads are considered as applied on the horizontal projection.

HOW TO USE TABLES: Enter table with span of rafters (upper figure in each square). Determine size and spacing (first column) based on stress grade (top row) and modulus of elasticity (lower figure in each square) of lumber to be used.

RAFTER SIZE AND SPACING		**ALLOWABLE EXTREME FIBER STRESS IN BENDING, "*Fb*," (psi)**									
(inches)	**(inches)**	**300**	**400**	**500**	**600**	**700**	**800**	**900**	**1000**	**1100**	**1200**
2 x 6	12.0	5-6 .19	6-4 .29	7-1 .41	7-9 .53	8-5 .67	9-0 .82	9-6 .98	10-0 1.15	10-6 1.33	11-0 1.51
	16.0	4-9 .16	5-6 .25	6-2 .35	6-9 .46	7-3 .58	7-9 .71	8-3 .85	8-8 1.00	9-1 1.15	9-6 1.31
	24.0	3-11 .13	4-6 .21	5-0 .29	5-6 .38	5-11 .48	6-4 .58	6-9 .69	7-1 .81	7-5 .94	7-9 1.07
2 x 8	12.0	7-3 .19	8-4 .29	9-4 .41	10-3 .53	11-1 .67	11-10 .82	12-7 .98	13-3 1.15	13-11 1.33	14-6 1.51
	16.0	6-3 .16	7-3 .25	8-1 .35	8-11 .46	9-7 .58	10-3 .71	10-10 .85	11-6 1.00	12-0 1.15	12-7 1.31
	24. 0	5-2 .13	5-11 .21	6-7 .29	7-3 .38	7-10 .48	8-4 .58	8-11 .69	9-4 .81	9-10 .94	10-3 1.07
2 x 10	12.0	9-3 .19	10-8 .29	11-11 .41	13-1 .53	14-2 .67	15-1 .82	16-0 .98	16-11 1.15	17-9 1.33	18-6 1.51
	16.0	8-0 .16	9-3 .25	10-4 .35	11-4 .46	12-3 .58	13-1 .71	13-10 .85	14-8 1.00	15-4 1.15	16-0 1.31
	24.0	6-6 .13	7-7 .21	8-5 .29	9-3 .38	10-0 .48	10-8 .58	11-4 .69	11-11 .81	12-6 .94	13-1 1.07
2x 12	12.0	11-3 .19	13-0 .29	14-6 .41	15-11 .53	17-2 .67	18-4 .82	19-6 .98	20-6 1.15	21-7 1.33	22-6 1.51
	16.0	9-9 .16	11-3 .25	12-7 .35	13-9 .46	14-11 .58	15-11 .71	16-10 .85	17-9 1.00	18-8 1.15	19-6 1.31
	24.0	7-11 .13	9-2 .21	10-3 .29	11-3 .38	12-2 .48	13-0 .58	13-9 .69	14-6 .81	15-3 .94	15-11 1.07
(inches)	**(inches)**	**1300**	**1400**	**1500**	**1600**	**1700**	**1800**	**1900**	**2000**	**2100**	**2200**
2 x 6	12. 0	11-5 1.70	11-11 1.91	12-4 2.11	12-8 2.33	13-1 2.55	13-6 2.78	13-10 3.01	14-2 3.25	14-6 3.50	14-10 3.75
	16.0	9-11 1.48	10-3 1.65	10-8 1.83	11-0 2.02	11-4 2.21	11-8 2.41	12-0 2.61	12-3 2.81	12-7 3.03	12-10 3.25
	24.0	8-1 1.21	8-5 1.35	8-8 1.49	9-0 1.65	9-3 1.80	9-6 1.96	9-9 2.13	10-0 2.30	10-3 2.48	10-6 2.65
2 x 8	12.0	15-1 1.70	15-8 1.91	16-3 2.11	16-9 2.33	17-3 2.55	17-9 2.78	18-3 3.01	18-9 3.25	19-2 3.50	19-7 3.75
	16.0	13-1 1.48	13-7 1.65	14-0 1.83	14-6 2.02	14-11 2.21	15-5 2.41	15-9 2.61	16-2 2.81	16-7 3.03	17-0 3.25
	24.0	10-8 1.21	11-1 1.35	11-6 1.49	11-10 1.65	12-2 1.80	12-7 1.96	12-11 2.13	13-3 2.30	13-7 2.48	13-10 2.65
2 x 10	12.0	19-3 1.70	20-0 1.91	20-8 2.11	21-4 2.33	22-0 2 .55	22.8 2.78	23-3 3.01	23-10 3.25	24-6 3.50	25-0 3.50
	16.0	16-8 1.48	17-4 1.65	17-11 1.83	18-6 2.02	19-1 2.21	19-7 2.41	20-2 2.61	20-8 2.81	21-2 3.03	21-8 3.25
	24.0	13-7 1.21	14-2 1.35	14-8 1.49	15-1 1.65	15-7 1.80	16-0 1.96	16-6 2.13	16-11 2.30	17-4 2.48	17-9 2.65
2x 12	12.0	23-5 1.70	24-4 1.91	25-2 2.11	26-0 2.33	26-9 2.55	27-6 2.78	28-3 3.01	29-0 3.25	20-9 3.50	30-5 3.75
	16.0	20-3 1.48	21-1 1.65	21-9 1.83	22-6 2.02	23-2 2.21	23-10 2.41	24-6 2.61	25-2 2.81	25-9 3.03	26-4 3.25
	24.0	16-7 1.21	17-2 135	17-9 1.49	18-4 1.65	18-11 1.80	19-6 1.96	20-0 2.13	20-6 2.30	21-1 2.48	21-6 2.65

For SI: 1 inch = 25,4 mm, 1 pound per square inch = 6.895 kPa, 1 pound per square foot = 0.0479 kN/m2.

NOTE: The modulus of elasticity, "E," in 1,000,000 pounds per square inch is shown below each span.

TABLE 3608.2.4s
ALLOWABLE SPANS FOR LOW OR HIGH SLOPE RAFTERS
40 Lbs. per Sq. Ft. Live Load
For Use in Snow Load Zone 4

DESIGN CRITERIA: Strength-40 Ibs. per sq. ft. live load plus 10 Ibs. per sq. ft. dead load determines fiber stress. Deflection—For 40 Ibs. per sq. ft. Iive load. Limited to span in inches divided by 180.

RAFTERS: Spans are measured along the horizontal projection and loads are considered as applied on the horizontal projection.

HOW TO USE TABLES: Enter table with span of rafters (upper figure in each square). Determine size and spacing (first column) based on stress grade (top row) and modulus of elasticity (lower figure in each square) of lumber to be used.

RAFTER SIZE AND SPACING		**ALLOWABLE EXTREME FIBER STRESS IN BENDING, "*Fb*," (psi)**										
(inches)	**(inches)**	**300**	**400**	**500**	**600**	**700**	**800**	**900**	**1000**	**1100**	**1200**	**1300**
2x6	12.0	5-6 0.11	6-4 0.17	7-1 0.23	7-9 0.30	8-5 0.38	9-0 0.47	9-6 0.56	10-0 0.66	10-6 0.76	11-0 0.86	11-5 0.97
	16.0	4-9 0.09	5-6 0.14	6-2 0.20	6-9 0.26	7-3 0.33	7-9 0.41	8-3 0.48	8-8 0.57	9-1 0.66	9-6 0.75	9-11 0.84
	24.0	3-10 0.08	4-6 0.12	5-0 0.16	5-6 0.22	5-11 0.27	6-4 0.33	6-9 0.40	7-1 0.47	7-5 0.54	7-9 0.61	8-1 0.69
2 x 8	12.0	7-3 0.11	8-4 0.17	9-4 0.23	10-3 0.30	11-1 0.38	11-10 0.47	12-6 0.56	13-3 0.66	13-10 0.76	14-6 0.86	15-1 0.97
	16.0	6-3 0.09	7-3 0.14	8-1 0.20	8-10 0.26	9-7 0.33	10-3 0.41	10-10 0.48	11-5 0.57	12-0 0.66	12-7 0.75	13-1 0.84
	24.0	5-1 0.08	5-11 0.12	6-7 0.16	7-3 0.22	7-10 0.27	8-4 0.33	8-10 0.40	9-4 0.47	9-9 0.54	10-3 0.61	10-8 0.69
2 x 10	12.0	9-3 0.11	10-8 0.17	11-11 0.23	13-1 0.30	14-1 0.38	15-1 0.47	16-0 0.56	16-10 0.66	17-8 0.76	18-6 0.86	19-3 0.97
	16.0	8-0 0.09	9-3 0.14	10-4 0.20	11-4 0.26	12-3 0.33	13-1 0.41	13-10 0.48	14-7 0.57	15-4 0.66	16-0 0.75	16-8 0.84
	24.0	6-6 0.08	7-6 0.12	8-5 0.16	9-3 0.22	10-0 0.27	10-8 0.33	11-4 0.40	11-11 0.47	12-6 0.54	13-1 0.61	13-7 0.69
2 x 12	12.0	11-3 0.11	13-0 0.17	14-6 0.23	15-11 0.30	17-2 0.38	18-4 0.47	19-6 0.56	20-6 0.66	21-6 0.76	22-6 0.86	23-5 0.97
	16.0	9-9 0.09	11-3 0.14	12-7 0.20	13-9 0.26	14-10 0.33	15-11 0.41	16-10 0.48	17-9 0.57	18-8 0.66	19-6 0.75	20-3 0.84
	24.0	8-0 0.08	9-2 0.12	10-3 0.16	11-3 0.22	12-1 0.27	13-0 0.33	13-9 0.40	14-6 0.47	15-3 0.54	15-11 0.61	16-6 0.69
(inches)	**(i nches)**	**1400**	**1500**	**1600**	**1700**	**1 800**	**1900**	**2000**	**2100**	**2200**	**2300**	**2400**
2 x 6	12 0	11-10 1.09	12-3 1.20	12-8 1.33	13-1 1.45	13-6 1.58	13-10 1.72	14-2 1.85	14-6 2.00	14-10 2.14	15-3 2.29	15-7 2.44
	16.0	10-3 0.94	10-8 1.04	11-0 1.15	11-4 1.26	11-8 1.37	12-0 1.49	12-3 1.61	12-7 1.73	12-11 1.85	13-2 1.98	13-5 2.11
	24.0	8-5 0.77	8-8 0.85	9-0 0.94	9-3 1.03	9-6 1.12	9-9 1.22	10-0 1.32	10-3 1.42	10-6 1.52	10-9 1.62	11-0 1.73
2x 8	12.0	15-8 1.09	16-2 1.20	16-9 1.33	17-3 1.45	17-9 1.58	18-3 1.72	18-9 1.85	19-2 2.00	19-8 2.14	20-1 2.29	20-6 2.44
	16.0	13-7 0.94	14-0 1.04	14-6 1.15	14-11 1.26	15-4 1.37	15-9 1.49	16-2 1.61	16-7 1.73	17-0 1.85	17-4 1.98	17-9 2.11
	24.0	11-1 0.77	11-5 0.85	11-10 0.94	12-3 1.03	12-6 1.12	12-11 1.22	13-3 1.32	13-7 1.42	13-10 1.52	14-2 1.62	14-6 1.73
2 x10	12.0	20-0 1.09	20-8 1.20	21-4 1.33	22-0 1.45	22-8 1.58	23-3 1.72	23-10 1.85	24-6 2.00	25-0 2.14	25-7 2.29	26-2 2.44
	16.0	17-3 0.94	17-11 1.04	18-6 1.15	19-1 1.26	19-8 1.37	20-2 1.49	20-8 1.61	21-2 1.73	21-8 1.85	22-2 1.98	22-8 2.11
	24.0	14-1 0.77	14-8 0.85	15-1 0.94	15-7 1.03	16-0 1.12	16-6 1.22	16-10 1.32	17-4 1.42	17-9 1.52	18-1 1.62	18-6 1.73
2x 12	12 0	24-3 1.09	25-2 1.20	26-0 1.33	26-9 1.45	27-7 1.58	28-3 1.72	29-0 1.85	29-9 2.00	30-5 2.14	31-1 2.29	31-10 2.44
	16.0	21-0 0.94	21-9 1.04	22-6 1.15	23-2 1.26	23-10 1.37	24-6 1.49	25-2 1.61	25-9 1.73	26-4 1.85	27-0 1.98	27-7 2.11
	24.0	17-2 0.77	17-9 0.85	18-4 0.94	18-11 1.03	19-6 1.12	20-0 1.22	20-6 1.32	21-1 1.42	21-7 1.52	22-0 1.62	22-6 1.73

For SI: 1 inch = 25.4 mm, 1 pound per square inch = 6.895 kPa, 1 pound per square foot = 0.0479 kN/m2.

NOTE: The modulus of elasticity, "*E*," in 1,000,000 pounds per square inch is shown below each span.

TABLE 3608.2.4t
ALLOWABLE SPANS FOR LOW OR HIGH SLOPE RAFTERS
40 Lbs. per Sq. Ft. Live Load (Supporting Gypsum Ceiling)
For Use in Snow Load Zone 4

DESIGN CRITERIA: Strength-40 lbs. per sq. ft. live load plus 10 lbs. per sq. ft. dead load determines fiber stress. Deflection—For 40 Ibs. per sq. ft. live load. Limited to span in inches divided by 240.

RAFTERS: Spans are measured along the horizontal projection and loads are considered as applied on the horizontal projection

HOW TO USE TABLES: Enter table with span of rafters (upper figure in each square). Determine size and spacing (first column) based on stress grade (top row) and modulus of elasticity (lower figure in each square) of lumber to be used.

RAFTER SIZE AND SPACING		ALLOWABLE EXTREME FIBER STRESS IN BENDING, "*Fb*," (psi)										
(inches)	**(inches)**	**300**	**400**	**500**	**600**	**700**	**800**	**900**	**1000**	**1100**	**1200**	**1300**
2 x 6	12.0	5-6 0.14	6-4 0.22	7-1 0.31	7-9 0.41	8-5 0.51	9-0 0.63	9-6 0.75	10-0 0.88	10-6 1.01	11-0 1.15	11-5 1.30
	16.0	4-9 0.12	5-6 0.19	6-2 0.27	6-9 0.35	7-3 0.44	7-9 0.54	8-3 0.65	8-8 0.76	9- 1 0.88	9-6 1.00	9- 11 1.12
	24.0	3-11 0.10	4-6 0.16	5-0 0.22	5-6 0.29	5-11 0.36	6-4 0.44	6-9 0.53	7-1 0.62	7-5 0.71	7-9 0.81	8-1 0.92
2 x 8	12.0	7-3 0.14	8-4 0.22	9-4 0.31	10-3 0.41	11-1 0.51	11-10 0.63	12-7 0.75	13-3 0.88	13-11 1.01	14-6 1.15	15-1 1.30
	16.0	6-3 0.12	7-3 0.19	8-1 0.27	8-11 0.35	9-7 0.44	10-3 0.54	10-11 0.65	11-6 0.76	12-0 0.88	12-7 1.00	13-1 1.12
	24.0	5-2 0.10	5-11 0.16	6-7 0.22	7-3 0.29	7-10 0.36	8-4 0.44	8-11 0.53	9-4 0.62	9-10 0.71	10-3 0.81	10-8 0.92
2 x 10	12.0	9-3 0.14	10-8 0.22	11-1 0.31	12-1 0.41	14-2 0.51	15-1 0.63	16-0 0.75	16-11 0.88	17-9 1.01	18-6 1.15	19-3 1.30
	16.0	8-0 0.12	9-3 0.19	10-4 0.27	11-4 0.35	12-3 0.44	13-1 0.54	13-11 0.65	14-8 0.76	15-4 0.88	16-0 1.00	16-8 1.12
	24.0	6-6 0.10	7-7 0.16	8-5 0.22	9-3 0.29	10-0 0.36	10-8 0.44	11-4 0.53	11- 11 0.62	12-6 0.71	13-1 0.81	13-7 0.92
2 x 12	12.0	11-3 0.14	13-0 0.22	14-6 0.31	15-11 0.41	17-2 0.51	18-4 0.63	19-6 0 75	20-6 0.88	21-7 1.01	22-6 1.15	23-5 1.30
	16.0	9-9 0.12	11-3 0.19	12-7 0.27	13-9 0.35	14-11 0.44	15-11 0.54	16-11 0.65	17-9 0.76	18-8 0.88	19-6 1.00	20-3 1.12
	24. 0	7-11 0.10	9-2 0.16	10-3 0.22	11-3 0.29	12-2 0.36	13-0 0.44	13-9 0.53	14-6 0.62	15-3 0.71	15-11 0.81	16-7 0.92
(Inches)	**(Inches)**	**1400**	**1500**	**1600**	**1700**	**1 600**	**1900**	**2000**	**2100**	**2200**	**2300**	**2400**
2 x 6	120	11-11 1.45	12-4 1.61	12-8 1.77	13-1 1.94	13-6 2.12	13-10 2.30	14-2 2.48	14-6 2.66	14-10 2.85	15-3 3.05	15-7 3.25
	16.0	10-3 1.26	10-8 1.39	11-0 1.54	11-4 1.68	11-8 1.83	12-0 1.99	12-4 2.15	12-7 2.31	12-11 2.48	13-2 2.64	13-5 2.82
	24.0	8-5 1.03	8-8 1.14	9-0 1.25	9-3 1.37	9-6 1.50	9-9 1.62	10-0 1.75	10-3 1.89	10-6 2.02	10-9 2.16	11-0 2.30
2 x 8	12.0	15-8 1.45	16-3 1.61	16-9 1.77	17-3 1.94	17-9 2.12	18-3 2.30	18-9 2.48	19-2 2.66	19-7 2.85	20-1 3.05	20-6 3.25
	16.0	13-7 1.26	14-0 1.39	14-6 1.54	14-11 1.68	15-5 1.83	15-10 1.99	16-3 2.15	16-7 2.31	17-0 2.48	17-4 2.64	17-9 2.82
	24.0	11-1 1.03	11-6 1.14	11-10 1.25	12-2 1.37	12-7 1.50	12-11 1.62	13-3 1.75	13-7 1.89	13-11 2.02	14-2 2.16	14-6 2.30
2 x 10	12.0	20-0 1.45	20-8 1.61	21-4 1.77	22-0 1.94	22-8 2.12	23-3 2.30	23-11 2 48	24-6 2.66	25-0 2.85	25-7 3.05	26-2 3.25
	16.0	17-4 1.26	17-11 1.39	18-6 1.54	19-1 1.68	19-7 1.83	20-2 1.99	20-8 2.15	21-2 2.31	21-8 2.48	22-2 2.64	22-8 2.82
	24.0	14-2 1.03	14-8 1.14	15-1 1.25	15-7 1.37	16-0 1.50	16-6 1.62	16-11 1.75	17-4 1.89	17-9 2.02	18-1 2.16	18-6 2.30
2 x 12	12.0	24-4 1.45	25-2 1.61	26-0 1.77	26-9 1.94	27-7 2.12	28-4 2.30	29-1 2.48	29-9 2.66	30-5 2.85	31-2 3.05	31-9 3.25
	16.0	21-1 1.26	21-9 1.39	22-6 1.54	23-2 1.68	23-10 1.83	24-6 1.99	25-2 2.15	25-9 2.31	26-5 2.48	27-0 2.64	27-7 2.82
	24.0	i7-2 1.03	17-9 1.14	18-4 1.25	18-11 1.37	19-6 1.50	20-0 1.62	20-6 1.75	21-1 1.89	21-7 2.02	22-0 2.16	22-6 2.30

For Sl: 1 inch = 25.4 mm, 1 pound per square inch = 6.895 kPa, 1 pound per square foot = 0.0479 kN/m'.

NOTE: The modulus of elasticity, "E," in 1,000,000 pounds per square inch is shown below each span.

TABLE 3608.2.4u
ALLOWABLE SPANS FOR LOW OR HIGH SLOPE RAFTERS
40 Lbs. per Sq. Ft. Live Load (Supporting Veneer Plaster Ceiling)
For Use in Snow Load Zone 4

DESIGN CRITERIA: Strength-40 Ibs. per sq. ft. live load plus 10 Ibs. per sq. ft. dead load determines fiber stress. Deflection—For 40 Ibs. per sq. ft. Iive load. Limited to span in inches divided by 360.

RAFTERS: Spans are measured along the horizontal projection and loads are considered as applied on the horizontal projection.

HOW TO USE TABLES: Enter table with span of rafters (upper figure in each square). Determine size and spacing (first column) based on stress grade (top row) and modulus of elasticity (lower figure in each square) of lumber to be used.

RAFTER SIZE AND SPACING		**ALLOWABLE EXTREME FIBER STRESS IN BENDING, "*Fb*," (psi)**										
(inches)	**(inches)**	**300**	**400**	**500**	**600**	**700**	**800**	**900**	**1000**	**1100**	**1200**	**1300**
2x6	12.0	5-6	6-4	7-1	7-9	8-5	9-0	9-6	10-0	10-6	11-0	11-5
		0.22	0.33	0.46	0.61	0.77	0.94	1.12	1.31	1.51	1.72	1.94
	16.0	4-9	5-6	6-2	6-9	7-3	7-9	8-3	8-8	9-1	9-6	9-11
		0.19	0.29	0.40	0.53	0.67	0.81	0.97	1.14	1.31	1.49	1.68
	24.0	3-11	4-6	5-0	5-6	5-11	6-4	6-9	7-1	7-5	7-9	8-1
		0.15	0.24	0.33	0.43	0.54	0.67	0.79	0.93	1.07	1.22	1.38
2 x 8	12.0	7-3	8-4	9-4	10-3	11-1	11-10	12-6	13-3	13-10	14-6	15-1
		0.22	0.33	0.46	0.61	0.77	0.94	1.12	1.31	1.51	1.72	1.94
	16.0	6-3	7-3	8-1	8-10	9-7	10-3	10-10	11-5	12-0	12-6	13-1
		0.19	0.29	0.40	0.53	0.67	0.81	0.97	1.14	1.31	1.49	1.68
	24.0	5-1	5-11	6-7	7-3	7-10	8-4	8-10	9-4	9-9	10-3	10-8
		0.15	0.24	0.33	0.43	0.54	0.67	0.79	0.93	1.07	1.22	1.38
2 x 10	12.0	9-3	10-8	11-11	13-1	14-1	15-1	16-0	16-10	17-9	18-6	19-3
		0.22	0.33	0.46	0.61	0.77	0.94	1.12	1.31	1.51	1.72	1.94
	16.0	8-0	9-3	10-4	11-4	12-3	13-1	13-10	14-7	15-4	16-0	16-8
		0.19	0.29	0.40	0.53	0.67	0.81	0.97	1.14	1.31	1.49	1.68
	24.0	6-6	7-6	8-6	9-3	10-0	10-8	11-4	11-11	12-6	13-1	13-7
		0.15	0.24	0.33	0.43	0.54	0.67	0.79	0.93	1.07	1.22	1.38
2 x 12	12.0	11-3	13-0	14-6	15-11	17-2	18-4	19-6	20-6	21-6	22-6	23-5
		0.22	0.33	0.46	0.61	0.77	0.94	1.12	1.31	1.51	1.72	1.94
	16.0	9-9	11-3	12-7	13-9	14-10	15-11	16-10	17-9	18-8	19-6	20-3
		0.19	0.29	0.40	0.53	0.67	0.81	0.97	1.14	1.31	1.49	1.68
	24.0	8-0	9-2	10-3	11-3	12-2	13-0	13-9	14-6	15-3	15-11	16-7
		0.15	0.24	0.33	0.43	0.54	0.67	0.79	0.93	1.07	1.22	1.38
(inches)	**(inches)**	**1400**	**1500**	**1600**	**1700**	**1 800**	**1900**	**2000**	**2100**	**2200**	**2300**	**2400**
2 x 6	12 0	11-10	12-3	12-8	13-1	13-6	13-10	14-2	14-6	14-10	15-3	15-7
		2.17	2.41	2.65	2.91	3.17	3.43	3.71	3.99	4.28	4.57	4.88
	16.0	10-3	10-8	11-0	11-4	11-8	12-0	12-3	12-7	12-11	13-2	13-6
		1.88	2.09	2.30	2.52	2.74	2.97	3.21	3.46	3.71	3.96	4.22
	24.0	8-5	8-9	9-0	9-3	9-6	9-9	10-0	10-3	10-6	10-9	11-0
		1.54	1.71	1.88	2.06	2.25	2.44	2.63	2.83	3.04	3.24	3.46
2 x 8	12.0	15-8	16-2	16-9	17-3	17-9	18-3	18-9	19-2	19-7	20-1	20-6
		2.17	2.41	2.65	2.91	3.17	3.43	3.71	3.99	4.28	4.57	4.88
	16.0	13-7	14-0	14-6	14-11	15-4	15-9	16-2	16-7	17-0	17-4	17-9
		1.88	2.09	2.30	2.52	2.74	2.97	3.21	3.46	3.71	3.96	4.22
	24.0	11-1	11-6	11-10	12-3	12-6	12-11	13-3	13-7	13-11	14-2	14-6
		1.54	1.71	1.88	2.06	2.25	2.44	2.63	2.83	3.04	3.24	3.46
2 x10	12.0	20-0	20-8	21-4	22-0	22-8	23-3	23-10	24-6	25-0	25-7	26-2
		2.17	2.41	2.65	2.91	3.17	3.43	3.71	3.99	4.28	4.57	4.88
	16.0	17-3	17-11	18-6	19-1	19-7	20-2	20-8	21-2	21-8	22-2	22-8
		1.88	2.09	2.30	2.52	2.74	2.97	3.21	3.46	3.71	3.96	4.22
	24.0	14-1	14-7	15-1	15-7	16-0	16-6	16-10	17-4	17-9	18-1	18-6
		1.54	1.71	1.88	2.06	2.25	2.44	2.63	2.83	3.04	3.24	3.46
2x 12	12 0	24-3	25-2	26-0	26-9	27-7	28-3	29-0	29-9	30-5	31-2	31-10
		2.17	2.41	2.65	2.91	3.17	3.43	3.71	3.99	4.28	4.57	4.88
	16.0	21-0	21-9	22-6	23-2	23-10	24-6	25-2	25-9	26-4	27-0	27-7
		1.88	2.09	2.30	2.52	2.74	2.97	3.21	3.46	3.71	3.96	4.22
	24.0	17-2	17-9	18-4	18-11	19-6	20-0	20-6	21-1	21-7	22-0	22-6
		1.54	1.71	1.88	2.06	2.25	2.44	2.63	2.83	3.04	3.24	3.46

For SI: 1 inch = 25.4 mm, 1 pound per square inch = 6.895 kPa, 1 pound per square foot = 0.0479 kN/m2.

NOTE: The modulus of elasticity, "*E*," in 1,000,000 pounds per square inch is shown below each span.

TABLE 3608.2.4v

ALLOWABLE SPANS FOR LOW OR HIGH SLOPE RAFTERS

40 Lbs. per Sq. Ft. Live Load

For Use in Snow Load Zone 4

DESIGN CRITERIA: Strength-40 Ibs. per sq. ft. live load plus 15 Ibs. per sq. ft. dead load determines fiber stress. Deflection—For 35 Ibs. per sq. ft. live load. Limited to span in inches divided by 180.

RAFTERS: Spans are measured along the horizontal projection and loads are considered as applied on the horizontal projection.

HOW TO USE TABLES: Enter table with span of rafters (upper figure in each square). Determine size and spacing (first column) based on stress grade (top row) and modulus of elasticity (lower figure in each square) of lumber to be used.

RAFTER SIZE AND SPACING		**ALLOWABLE EXTREME FIBER STRESS IN BENDING, "*Fb*," (psi)**										
(inches)	**(inches)**	**300**	**400**	**500**	**600**	**700**	**800**	**900**	**1000**	**1100**	**1200**	**1300**
2x6	12.0	5-3 0.09	6-1 0.14	6-9 0.20	7-5 0.26	8-0 0.33	8-7 0.41	9-1 0.49	9-7 0.57	10-0 0.66	10-6 0.75	10-11 0.84
	16.0	4-6 0.08	5-3 0.12	5- 10 0.17	6-5 0.23	6- 11 0.29	7-5 0.35	7- 10 0.42	8-3 0.49	8-8 0.57	9- 1 0.65	9-5 0.73
	24.0	3-8 0.07	4-3 0.10	4-9 0.14	5-3 0.19	5-8 0.24	6-1 0.29	6-5 0.34	6-9 0.40	7-1 0.46	7-5 0.53	7-9 0.60
2 x 8	12.0	6-11 0.09	8-0 0.14	8-11 0.20	9-9 0.26	10-7 0.33	11-3 0.41	12-0 0.49	12-7 0.57	13-3 0.66	13-10 0.75	14-5 0.84
	16.0	6-0 0.08	6-11 0.12	7-9 0.17	8-6 0.23	9-2 0.29	9-9 0.35	10-4 0.42	10-11 0.49	11-6 0.57	12-0 0.65	12-6 0.73
	24.0	4-11 0.07	5-8 0.10	6-4 0.14	6-11 0.19	7-6 0.24	8-0 0.29	8-6 0.34	8-11 0.40	9-4 0.46	9-9 0.53	10-2 0.60
2 x 10	12.0	8-10 0.09	10-2 0.14	11-5 0.20	12-6 0.26	13-6 0.33	14-5 0.41	15-3 0.49	16-1 0.57	16-11 0.66	17-8 0.75	18-4 0.84
	16.0	7-8 0.08	8-10 0.12	9-10 0.17	10-10 0.23	11-8 0.29	12-6 0.35	13-3 0.42	13-1 1 0.49	14-8 0.57	15-3 0.65	15-11 0.73
	24.0	6-3 0.07	7-2 0.10	8-1 0.14	8-10 0.19	9-6 0.24	10-2 0.29	10-10 0.34	11-5 0.40	11-11 0.46	12-6 0.53	13-0 0.60
2 x 12	12.0	10-9 0.09	12-4 0.14	13-10 0.20	15-2 0.26	16-4 0.33	17-6 0.41	18-7 0.49	19-7 0.57	20-7 0.66	21-6 0.75	22-4 0.84
	16.0	9-3 0.08	10-9 0.12	12-0 0.17	13-1 0.23	14-2 0.29	15-2 0.35	16-1 0.42	17-0 0.49	17-9 0.57	18-7 0.65	19-4 0.73
	24.0	7-7 0.07	8-9 0.10	9-9 0.14	10-9 0.19	11-7 0.24	12-4 0.29	13-1 0.34	13-10 0.40	14-6 0.46	15-2 0.53	15-9 0.60
(inches)	**(inches)**	**1400**	**1500**	**1600**	**1700**	**1 800**	**1900**	**2000**	**2100**	**2200**	**2300**	**2400**
2 x 6	12 0	11-4 0.94	11-9 1.05	12-1 1.15	12-6 1.26	12-10 1.38	13-2 1.49	13-6 1.61	13-10 1.73	14-2 1.86	14-6 1.99	14-10 2.12
	16.0	9-10 0.82	10-2 0.91	10-6 1.00	10-10 1.09	11-1 1.19	11-5 1.29	11-9 1.40	12-0 1.50	12-4 1.61	12-7 1.72	12-10 1.83
	24.0	8-0 0.67	8-3 0.74	8-7 0.82	8-10 0.89	9-1 0.97	9-4 1.06	9-7 1.14	9-10 1.23	10-0 1.31	10-3 1.41	10-6 1.50
2 x8	12.0	14-11 0.94	15-5 1.05	16-0 1.15	16-5 1.26	16-11 1.38	17-5 1.49	17-10 1.61	18-3 1.73	18-9 1.86	19-2 1.99	19-7 2.12
	16.0	12-11 0.82	13-5 0.91	13-10 1.00	14-3 1.09	14-8 1.19	15-1 1.29	15-5 1.40	15-10 1.50	16-3 1.61	16-7 1.72	16-11 1.83
	24.0	10-7 0.67	10-11 0.74	11-3 0.82	11-8 0.89	12-0 0.97	12-4 1.06	12-7 1.14	12-11 1.23	13-3 1.31	13-6 1.41	13-10 1.50
2 x10	12.0	19- 1 0.94	19-9 1.05	20-4 1.15	21-0 1.26	21-7 1.38	22-2 1.49	22-9 1.61	23-4 1.73	23- 11 1.86	24-5 1.99	24-11 2.12
	16.0	16-6 0.82	17-1 0.91	17-8 1.00	18-2 1.09	18-9 1.19	19-3 1.29	19-9 1.40	20-2 1.50	20-8 1.61	21-2 1.72	21-7 1.83
	24.0	13-6 0.67	13-11 0.74	14-5 0.82	14-10 0.89	15-3 0.97	15-8 1.06	16-1 1.14	16-6 1.23	16-11 1.31	17-3 1.41	17-8 1.50
2x 12	12 0	23-2 0.94	24-0 1.05	24-9 1.15	25-6 1.26	26-3 1.38	27-0 1.49	27-8 1.61	28-4 1.73	29-1 1.86	29-9 1.99	30-4 2.12
	16.0	20-1 0.82	20-9 0.91	21-5 1.00	22-1 1.09	22-9 1.19	23-4 1.29	24-0 1.40	24-7 1.50	25-2 1.61	25-9 1.72	26-3 1.83
	24.0	16-4 0.67	17-0 0.74	17-6 0.82	18-1 0.89	18-7 0.97	19-1 1.06	19-7 1.14	20-1 1.23	20-6 1.31	21-0 1.41	21-5 1.50

For SI: 1 inch = 25.4 mm, 1 pound per square inch = 6.895 kPa, 1 pound per square foot = 0.0479 kN/m2.

NOTE: The modulus of elasticity, "*E*," in 1,000,000 pounds per square inch is shown below each span.

TABLE 3608.2.4w
ALLOWABLE SPANS FOR LOW OR HIGH SLOPE RAFTERS
40 Lbs. per Sq. Ft. Live Load (Supporting Gypsum Ceiling)
For Use in Snow Load Zone 4

DESIGN CRITERIA: Strength—15 lbs. per sq. ft. dead load plus 40 lbs. per sq. ft. live load determines fiber stress. Deflection—For 40 lbs. per sq. ft. live load. Limited to span in inches divided by 240.

RAFTERS: Spans are measured along the horizontal projection and loads are considered as applied on the horizontal projection.

HOW TO USE TABLES: Enter table with span of rafters (upper figure in each square). Determine size and spacing (first column) based on stress grade (top row) and modulus of elasticity (lower figure in each square) of lumber to be used.

RAFTER SIZE AND SPACING		ALLOWABLE EXTREME FIBER STRESS IN BENDING, 'Fb," (psi)										
(inches)	(inches)	300	400	500	600	700	800	900	1000	1100	1200	1300
2 x 6	12.0	5-3 0.12	6-1 0.19	6-9 0.27	7-5 0.35	8-0 0.44	8-7 0.54	9-1 0.65	9-7 0.76	10-0 0.88	10-6 1.00	10-11 1.13
	16.0	4-6 0.11	5-3 0.17	5-10 0.23	6-5 0.31	6-11 0.39	7-5 0.47	7-10 0.56	8-3 0.66	8-8 0.76	9-1 0.86	9-5 0.98
	24.0	3-8 0.09	4-3 0.14	4-9 0.19	5-3 0.25	5-8 0.31	6-1 0.38	6-5 0.46	6-9 0.54	7-1 0.62	7-5 0.71	7-9 0.80
2 x 8	12.0	6-11 0.12	8-0 0.19	8-11 0.27	9-9 0.35	10-7 0.44	11-3 0.54	12-0 0.65	12-7 0.76	13-3 0.88	13-10 1.00	14-5 1.13
	16.0	6-0 0.11	6- 11 0.17	7-9 0.23	8-6 0.31	9-2 0.39	9-9 0.47	10-4 0.56	10- 11 0.66	11 -6 0.76	12-0 0.86	12-6 0.98
	24.0	4-11 0.09	5-8 0.14	6-4 0.19	6-11 0.25	7-6 0.31	8-0 0.38	8-6 0.46	8-11 0.54	9-4 0.62	9-9 0.71	10-2 0.80
2x 10	12.0	8-10 0.12	10-2 0.19	11-5 0.27	12-6 0.35	13-6 0.44	14-5 0.54	15-3 0.65	16-1 0.76	16-11 0.88	17-8 1.00	18-4 1.13
	16.0	7-8 0.11	8-10 0.17	9-10 0.23	10-10 0.31	11-8 0.39	12-6 0.47	13-3 0.56	13-11 0.66	14-8 0.76	15-3 0.86	15-11 0.98
	24.0	6-3 0.09	7-2 0.14	8-1 0.19	8-10 0.25	9-6 0.31	10-2 0.38	10-10 0.46	11-5 0.54	11-11 0.62	12-6 0.71	13-0 0.80
2 x 12	12.0	10-9 0.12	12-5 0.19	13- 10 0.27	15-2 0.35	16-5 0.44	17-6 0.54	18-7 0.65	19-7 0.76	20-6 0.88	21 -5 1.00	22-4 1.13
	16.0	9-3 0.11	10-9 0.17	12-0 0.23	13-2 0.31	14-2 0.39	15-2 0.47	16-1 0.56	17-0 0.66	17-9 0.76	18-7 0.86	19-4 0.98
	24.0	7-7 0.09	8-9 0.14	9-10 0.19	10-9 0.25	11-7 0.31	12-5 0.38	13-2 0.46	13-10 0.54	14-6 0.62	15-2 0.71	15-9 0.80
(inches)	(inches)	1400	1500	1600	1700	1 800	1900	2000	2100	2200	2300	2400
2 x 6	120	11-4 1.26	11-9 1.40	12-1 1.54	12-6 1.68	12-10 1.83	13-2 1.99	13-6 2.15	13-10 2.31	14-2 2.48	14-6 2.65	14-10 2.82
	16.0	9-10 1.09	10-2 1.21	10-6 1.33	10-10 1.46	11-1 1.59	11-5 1.72	11-9 1.86	12-0 2.00	12-4 2.15	12-7 2.29	12-10 2.45
	24.0	8-0 0.89	8-3 0.99	8-7 1.09	8- 10 1.19	9- 1 1.30	9-4 1.41	9-7 1.52	9- 10 1.63	10-0 1.75	10-3 1.87	10-6 2.00
2 x 8	12.0	14-11 1.26	15-5 1.40	16-0 1.54	16-5 1.68	16-11 1.83	17-5 1.99	17-10 2.15	18-3 2.31	18-9 2.48	19-2 2.65	19-7 2.82
	16. 0	12-11 1.09	13-5 1.21	13-10 1.33	14-3 1.46	14-8 1.59	15-1 1.72	15-5 1.86	15-10 2.00	16-3 2.15	16-7 2.29	16-11 2.45
	24.0	10-7 0.89	10-11 0.99	11-3 1.09	11-8 1.19	12-0 1.30	12-4 1.41	12-7 1.52	12-11 1.63	13-3 1.75	13-6 1.87	13-10 2.00
2x 10	12.0	19- 1 1.26	19-9 1.40	20-4 1.54	21 -0 1.68	21 -7 1.83	22-2 1.99	22-9 2.15	23-4 2.31	23-11 2.48	24-5 2.65	25-0 2.82
	16.0	16-6 1.09	17-1 1.21	17-8 1.33	18-2 1.46	18-9 1.59	19-3 1.72	19-9 1.86	20-2 2.00	20-8 2.15	21-2 2.29	21-7 2.45
	24.0	13-6 0.89	13-11 0.99	14-5 1.09	14-10 1.19	15-3 1.30	15-8 1.41	16-1 1.52	16-6 1.63	16-11 1.75	17-3 1.87	17-8 2.00
2x 12	12.0	23-2 1.26	24-0 1.40	24-9 1.54	25-6 1.68	26-3 1.83	27-0 1.99	27-8 2.15	28-5 2.31	29- 1 2.48	29-9 2.65	30-4 2.00
	16.0	20- 1 1.09	20-9 1.21	21 -5 1.33	22- 1 1.46	22-9 1.59	23-5 1.72	24-0 1.86	24-7 2.00	25-2 2.15	25-9 2.29	26-3 2.45
	24.0	16-5 0.89	17-0 0.99	17-6 1.09	18- 1 1.19	18-7 1.30	19- 1 1.41	19-7 1.52	20- 1 1.63	20-6 1.75	21-0 1.87	21 -5 2.00

For SI: 1 inch = 25.4 mm, 1 pound per square inch = 6.895 kPa, 1 pound per square foot = 0 0479 kN/m2.

NOTE: The modulus of elasticity, "E," in 1,000,000 pounds per square inch is shown below each span.

TABLE 3608.2.4x
ALLOWABLE SPANS FOR LOW OR HIGH SLOPE RAFTERS
40 Lbs. per Sq. Ft. Live Load (Supporting Veneer Plaster Ceiling)
For Use in Snow Load Zone 4

DESIGN CRITERIA: Strength—15 lbs. per sq. ft. dead load plus 40 lbs. per sq. ft. live load determines fiber stress. Deflection—For 40 lbs. per sq. ft. live load. Limited to span in inches divided by 360.

RAFTERS: Spans are measured along the horizontal projection and loads are considered as applied on the horizontal projection.

HOW TO USE TABLES: Enter table with span of rafters (upper figure in each square). Determine size and spacing (first column) based on stress grade (top row) and modulus of elasticity (lower figure in each square) of lumber to be used.

RAFTER SPACING AND SIZE		ALLOWABLE EXTREME FIBER STRESS IN BENDING, "*Fb*," (psi)									
(inches)	**(inches)**	**300**	**400**	**500**	**600**	**700**	**300**	**900**	**1000**	**1100**	**1200**
2x6	12.0	5-3 0.19	6-1 0.29	6-9 0.40	7-5 0.53	8-0 0.67	8-7 0.82	9-1 0.97	9-7 1 14	10-0 1 31	10-6 1 50
	16 0	4-6 0.16	5-3 025	5-10 035	6-5 046	6-11 058	7-5 071	7-10 084	8-3 099	8-8 1 14	9-1 1 30
	24.0	3-8 0.13	4-3 0.20	4-9 0.28	5-3 0.37	5-8 0.47	6-1 0.58	6-5 0.69	6-9 0.81	7-1 0.93	7-5 1.06
2x8	12.0	6-11 0.19	8-0 0.29	8-11 0.40	9-9 0.53	10-7 0.67	11-3 0.82	12-0 0.97	12-7 1.14	13-3 1.31	13-10 1.50
	16.0	6-0 0.16	6-11 0.25	7-9 0.35	8-6 0.46	9-2 0.58	9-9 0.71	10-4 0.84	10-11 0.99	11-6 1.14	12-0 1.30
	24.0	4-11 0.13	5-8 0.20	6-4 0.28	6-11 0.37	7-6 0.47	8-0 0.58	8-6 0.69	8-11 0.81	9-4 .093	9-9 1.06
2x 10	12.0	8-10 0.19	10-2 0.29	11-5 040	12-6 053	13-6 067	14-5 082	15-3 097	16-1 1 14	16-11 1 31	17-8 1 50
	16.0	7-8 0.16	8-10 0.25	9-10 0.35	10-10 0.46	11-8 0.58	12-6 0.71	13-3 0.84	13-11 0.99	14-8 1 14	15-3 1.30
	24.0	6-3 0.13	7-2 0.20	8-1 0.28	8-10 0.37	9-6 0.47	10-2 0.58	10-10 0.69	11-5 0.81	11-11 0.93	12-6 1.06
2x 12	12.0	10-9 0.19	12-5 0.29	13-10 0.40	15-2 0.53	16-5 0.67	17-6 0.82	18-7 0.97	19-7 1.14	20-6 1.31	21-5 1.50
	16.0	9-3 0.16	10-9 0.25	12-0 0.35	13-2 0.46	14-2 0.58	15-2 0.71	16-1 0.84	17-0 0.99	17-9 1.14	18-7 1 30
	24 0	7-7 0.13	8-9 0.20	9-10 0.28	10-9 0..37	11-7 0.47	12-5 0.58	13-2 0.69	13-10 0.81	14-6 0.93	15-2 1.06
(inches)	**(inches)**	**1300**	**1400**	**1500**	**1600**	**1700**	**1800**	**1900**	**2000**	**2100**	**2200**
2 x 6	12.0	10-11 1.69	11-4 1.89	11-9 2.09	12-1 2.31	12-6 2.53	12-10 2.75	13-2 2.98	13-6 3.22	13-10 3.47	14-2 3.72
	16.0	9-5 1.46	9-10 1.63	10-2 1.81	10-6 2.00	10-10 2.19	11-1 2.38	11-5 2.58	11-9 2.79	12-0 3.00	12-3 3.22
	24.0	7-9 1.19	8-0 1.33	8-3 1.48	8-7 1.63	8-10 1.79	9-1 1.95	9-4 2.11	9-7 2.28	9-10 2.45	10-0 2.63
2 x 8	12.0	14-5 1.69	14-11 1.89	15-5 2.09	16-0 2.31	16-5 2.53	16-11 2.75	17-5 2.98	17-10 3.22	18-4 3.47	18-9 3.72
	16.0	12-6 1.46	12-11 1.63	13-5 1.81	13-10 2.00	14-3 2.19	14-8 2.38	15-1 2.58	15-6 2.79	15-10 3.00	16-2 3.22
	24.0	10-2 1.19	10-7 1.33	10-11 1.48	11-3 1.63	11-8 1.79	12-0 1.95	12-4 2.11	12-7 2.28	12-11 2.45	13-3 2.63
2x 10	12.0	18-4 1.69	19-1 1.89	19-9 2.09	20-4 2.31	21-0 2.53	21-7 2.75	22-2 2.98	22-9 3.22	23-4 3.47	23-10 3.72
	16.0	15-11 1.46	16-6 1.63	17-1 1.81	17-8 2.00	18-2 2.19	18-9 2.38	19-3 2.58	19-9 2.79	20-2 3.00	20-8 3.22
	24.0	13-0 1.19	13-6 1.33	13-11 1.48	14-5 1.63	14-10 1.79	15-3 1.95	15-8 2.11	16-1 2.28	16-6 2.45	16-10 2.63
2 x 12	12 0	22-4 1.69	23-2 1.89	24-0 2.09	24-9 2.31	25-6 2.53	26-3 2.75	27-0 2.98	27-9 3.22	28-4 3.47	29-1 3.72
	16.0	19-4 1.46	20-1 1.63	20-9 1.81	21-5 2.00	22-1 2.19	22-9 2.38	23-5 2.58	24-0 2.79	24-7 3.00	25-2 3.22
	24.0	15-9 1.19	16-5 1.33	17-0 1.48	17-6 1.63	18-1 1.79	18-7 1.95	19-1 2.11	19-7 2.28	20-1 2.45	20-6 2.63

For SI: 1 inch = 25.4 mm, 1 pound per square inch = 6.895 kPa, 1 pound per square foot = 0.0479 kN/m2.

NOTE: The modulus of elasticity, "E," in 1,000,000 pounds per square inch is shown below each span.

NON-TEXT PAGE

ROOF COVERINGS

3609.1 GENERAL

3609.1.1 Application: The provisions of 780 CMR 3609.1 shall control the design and construction of roof coverings for all buildings. Roof coverings shall be listed for their intended use. Materials for which listing is not available shall be required to be approved by the ***State Board of Building Regulations and Standards in accordance with 780 CMR 109.3.4.***

3609.1.2 Requirements: The roof covering shall be capable of accommodating the loads indicated in ***780 CMR 3603.1*** and provide a barrier against the weather to protect supporting elements and the structure beneath.

3609.1.3 Roofing covering materials: Roofs shall be covered with materials as set forth in ***780 CMR 3609.3 through 3609.9.*** Classified roofing shall conform to UL 790, ***as listed in Appendix A,*** and shall be installed when the edge of the roof is less than three feet (914 mm) from a property line ***or as required by city or town ordinance or bylaw***. The roofing materials set forth in ***780 CMR 3609.4 through 3609.6*** and concrete slabs may be accepted as Class A roofing.

780 CMR 3609.2 DECK PREPARATION

3609.2.1 Supporting construction: Roofing shall be applied only when the supporting roof construction is clean and dry.

3609.2.2 Single layer underlayment: When a single ply of underlayment is required, it shall be laid parallel to the eaves with a two-inch (51 mm) top lap and four-inch (102 mm) end lap nailed sufficiently to hold in place.

3609.2.3 Multiple layer underlayment: When two layers of underlayment are required, they shall be laid shingle fashion parallel to the eaves with 19-inch (483 mm) top lap and 12-inch (305 mm) end lap, with end laps located at least six feet (1829 mm) from end laps in the preceding course, and blind nailed sufficiently to hold in place.

780 CMR 3609.3 ASPHALT SHINGLES

3609.3.1 General: Asphalt shingles shall be applied only to solidly sheathed roofs Asphalt shingles shall be applied according to the manufacturer's printed instructions and 780 CMR 36.

3609.3.2 Slopes of four units vertical in 12 units horizontal (33% slope) or greater: Asphalt shingle roofs shall have an underlayment of not less than one ply of No. 15 felt, applied as required in ***780 CMR 3609.2*** and Table ***3609.3.4***.

3609.3.3 Slopes less than four units vertical in 12 units horizontal (33% slope) but not less than two units vertical in 12 units horizontal (17% slope): Nominally double-coverage asphalt shingles may be installed on slopes as low as two units vertical in 12 units horizontal (17% slope), provided the shingles are approved self-sealing shingles or are hand sealed and are installed with an underlayment consisting of two layers of No. 15 felt, applied as required in ***780 CMR 3609.2*** and Table ***3609.3.4.*** The two layers of felt shall be cemented together, in addition to the required nailing, from the eaves up the roof to overlie a point 24 inches (610 mm) inside the interior wall line of the building. Asphalt shingles shall not be used on roofs with slopes less than two units vertical in 12 units horizontal (17% slope).

3609.3.4 Fasteners: Asphalt shingles shall be fastened according to the manufacturer's printed instructions and Table ***3609.3.4***.

3609.3.5 Valley flashing: Roof valleys shall be flashed by one of the methods listed in ***780 CMR 3609.3.5.1 through 3609.3.5.3***. Asphalt shingles shall be applied according to the manufacturer's printed instructions.

3609.3.5.1 Sheet metal: Open roof valleys may be provided of not less than No. 28 gage galvanized corrosion-resistant sheet metal and shall extend at least eight inches (203 mm) from the center line each way. Sections of flashing shall be jointed to provide an adequate water lock.

TABLE 3609.3.4
ASPHALT SHINGLE APPLICATION

ROOF OF SLOPE	NOT PERMITTED BELOW 2:12	
	2:12 to less than 4:12	**4:12 and over**
DECK REQUIREMENT	Asphalt shingles shall be fastened to solidly sheathed roofs. Sheathing shall conform to Tables 3605.3.2.1.1a and 3608.3.3.2	
UNDERLAYMENT Temperate climate	Asphalt strip shingles may be installed on slopes as low as two inches in twelve inches, provided the shingles are approved self-sealing or are hand sealed and are installed with an underlayment consisting of two layers of nonperforated Type 15 felt applied shingle fashion. Starting with an 18-inch-wide sheet and a 36-inch-wide sheet over the eaves, each subsequent sheet shall be lapped 19 inches horizontally.	One layer nonperforated Type 15 felt lapped two inches horizontally and four inches vertically to shed water.
Severe climate: In areas subject to wind-driven snow or roof ice buildup.	Same as for temperate climate, and additionally the two layers shall be solid cemented together with approved cementing material between the plies extending from the eave up the roof to a line 24 inches inside the exterior wall line of the building.	Same as for temperature climate, except that one layer No. 40 coated roofing or coated glass base sheet shall be applied from the eaves to a line 12 inches inside the exterior wall line with all laps cemented together.
ATTACHMENT Type of fasteners	Corrosion-resistant nails, minimum 12-gage ⅜-inch head, or approved corrosion-resistant staples, minimum 16-gage $^{15}/_{16}$-inch-crown width.	
	Fasteners shall be long enough to penetrate into the sheathing ¾ inch or through the thickness of the sheathing, whichever is less.	
No. of fasteners[1]	four per 36-40 inch strip two per nine-18-inch strip	
Exposure Field of roof	Per manufacturer's instructions included with packages of shingles.	
Hips and ridges	Hip and ridge weather exposures shall not exceed those permitted for the field of the roof	
Method	Per manufacturer's instructions included with packages of shingles.	
FLASHINGS		
Valleys	Per 780 CMR 3609.3.5	
Other flashings	Per 780 CMR 3609.3.6 and 3609.3.7	

For SI: 1 inch = 25.4 mm.

[1] Figures shown are for normal application. For special conditions such as mansard application and where roofs are in special wind regions, shingles shall be attached per manufacturer's instructions.

3609.3.5.2 Roll roofing: Woven or closed valleys may be constructed by centering 36-inch-wide (914 mm) roll roofing material not less than Type 50 in the valley over the underlayment.

3609.3.5.3 Multiple layer flashing: Roof valley flashing may be of laced composition shingles, applied in an approved manner, with an underlay not less than 30-pound (14 kg) felt extending ten inches (254 mm) from the center line each way, or shall be of two layers of 90-pound (41 kg) mineral-surfaced cap sheet cemented together with the bottom layer not less than 12 inches (305 mm) wide laid face down and the top layer not less than 24 inches (610 mm) wide laid face up.

3609.3.6 Side wall flashing: Flashing against a vertical sidewall shall be by the step-flashing method.

Exception: Other methods shall be permitted when installed in accordance with the shingle manufacturer's printed instructions.

3609.3.7 Other flashing: Flashings against vertical front wall, as well as soil stack, vent pipe and chimney flashing, shall be applied according to asphalt shingle manufacturer's printed instructions.

3609.3.8 Hips and ridges: Hip and ridge shingles shall be fastened according to the manufacturer's printed instructions and Table ***3609.3.4.***

780 CMR 3609.4 SLATE SHINGLES

3609.4.1 General: Slate shingles shall be applied in an approved manner and securely fastened with corrosion-resistant nails or corrosion-resistant nails and wire.

3609.4.2 Slate shingles: Slate shingles shall conform to ASTM C406 as listed in Appendix A. Slate shingles shall not be installed on roof slopes below two units vertical in 12 units horizontal (2:12). Double-layer No. 15 felt underlayment shall be required on roof slopes below four units vertical in 12 units horizontal (4:12). Single-layer No. 15 felt underlayment shall be required on all other roof slopes. Slate shingles shall be secured to the roof with two fasteners per slate. The minimum slate headlap shall be three inches (76 mm).

3609.4.3 Valleys: Roof valley flashing shall be provided of not less than No. 28 gage galvanized corrosion-resistant sheet metal and shall extend at least 11 inches (279 mm) from the center line each way and shall have a splash diverter rib not less than one inch (25 mm) high at the flow line formed as part of the flashing. Sections of flashing shall have an end lap of not less than six inches (153 mm) and shall be provided with an adequate water lock.

780 CMR 3609.5 METAL

3609.5.1 General: Flat sheets or shingles shall be applied only to solid sheathed roofs. Metal roofing shall be applied in an approved manner ***consistent with the manufacturer's recommendations***.

3609.5.2 Materials: Metal roofing shall conform to AA ASM 35, or ASTM A 361 or B 209, ***as listed in Appendix A***.

3609.5.3 Metal shingles: Metal shingles shall not be installed on roof slopes below four units vertical in 12 units horizontal (4:12). Single-layer underlayment of No. 30 felt is required for all metal shingles other than flat metal shingles on all roof slopes.

780 CMR 3609.6 TILE, CLAY OR CONCRETE SHINGLES

3609.6.1 Attachment: All roof tile shall be securely fastened with corrosion-resistant nails or corrosion-resistant nails and wire, or other approved means.

3609.6.2 Interlocking clay or cement tile: Interlocking clay or cement tile shall be installed only over solid sheathing or spaced structural sheathing boards. Interlocking clay or cement tile shall not be installed on roof slopes below four units vertical in 12 units horizontal (4:12). Horizontal battens shall be required on roof slopes over seven units vertical in 12 units horizontal (7:12). Single-layer underlayment is required over solid sheathing on all roof slopes. Reinforced underlayment shall be required where spaced sheathing is installed. Regardless of roof slope, the first three tile courses and all tile within three feet (914 mm) of roof edges, changes in roof slope or changes in slope direction, shall be fastened to the roof. For the field of the roof, fastening is not required on roof slopes below five units vertical in 12 units horizontal (5:12); every tile course shall be fastened on roof slopes five units vertical in 12 units horizontal (5:12) to less than 12 units vertical in 12 units horizontal (12:12); and every tile shall be fastened on roof slopes 12 units vertical in 12 units horizontal (12:12) and over. Tile overlap shall be in accordance with approved manufacturer's installation instructions.

3609.6.3 Noninterlocking clay or cement tile: Noninterlocking clay or cement tile shall not be installed on roof slopes below 2½ units vertical in 12 units horizontal (2½:12). Double-layer underlayment is required on roof slopes below three units vertical in 12 units horizontal (3:12). Single-layer underlayment is required on all other roof slopes. Noninterlocking clay or cement tile shall be secured to the roof with two fasteners per tile. The minimum tile overlap shall be three inches (76 mm).

3609.6.4 Tile lugs: Tile with projection anchor lugs at the bottom of the tile shall be held in position by means of one-inch-by-two-inch wood (25 mm by 51 mm) stripping, treated to resist moisture deterioration, nailed to the roof sheathing over the underlayment or other approved means.

3609.6.5 Nailing and flashing: Nailing and valley flashing shall be the same as required for slate shingles.

780 CMR 3609.7 BUILT-UP ROOFING

3609.7.1 Decking: Built-Up roofing shall be applied only to solid surface roof decks.

3609.7.2 Materials: Built-Up roofing shall conform to UL 55A ***as listed in Appendix A***.

3609.7.3 Underlayment: An underlayment of one layer sheathing paper is required under built-up roofing assemblies when the roof deck is constructed of sheathing boards Underlayment is to be applied as specified in *780 CMR 3609.2*.

3609.7.4 Base ply: On nailable decks, a base ply is to be fastened to the deck in accordance with the manufacturer's published specifications and Table **3609.3.4**.

3609.7.4.1 Nonnailable decks: On nonnailable decks, cast-in-place concrete or precast concrete, a base ply required by manufacturer's specification shall be cemented or spot mopped to a primed deck as required by the type of deck material, using not less than 20 pounds (9.1 kg) per square of hot asphalt for solid mopping, or not less than ten pounds (4.5 kg) per square for spot mopping, or not less than 1½ gallons (5.7 L) per square of cold bituminous compound, or 25 pounds (11 kg) per square of coal-tar pitch, in accordance with the manufacturer's published specifications. If a base ply is not used, a minimum of three roofing plies applied shingle fashion shall be solidly cemented to the primed deck and cemented together, using no less cementing material than that specified for a solidly cemented base ply.

3609.7.4.2 Insulated decks: On insulated decks, a vapor retarder shall be installed between the deck and the insulation. Insulation shall be of a rigid type suitable for application of a roof covering. The insulation must be properly attached using mechanical fasteners Type II or Type III asphalt in accordance with ASTM D 312, ***as listed in Appendix A***. and installed in accordance with the manufacturer 's published ply specifications. The insulation may be taped if required. A base ply required by the manufacturer's specification shall be solidly cemented to the insulation, using no less cementing material than that specified for a solidly cemented base ply to a primed nonnailable deck. If a base ply is not used, a minimum of three roofing plies applied shingle fashion shall be solidly cemented to the insulation and cemented together, using no less cementing material than that specified for a solidly cemented base ply.

3609.7.5 Membrane over base ply: A minimum of two successive layers of roofing plies shall be solidly cemented shingle fashion to the base ply, using no less cementing material than that specified for a solidly cemented base ply.

3609.7.6 Surfacing: The built-up roofing assembly shall be surfaced by one of the methods described in *780 CMR 3609.7.6.1 and 3609.7.6.2.*

3609.7.6.1 Mineral aggregate roofs: Mineral aggregate surfaced roofs shall be surfaced with not less than 60 pounds (27 kg) of hot asphalt or 75 pounds (34 kg) of coal-tar pitch in which is embedded not less than 400 pounds (181 kg) of gravel or 300 pounds (136 kg) of crushed slag per roofing square.

3609.7.6.2 Mineral-surfaced cap roofs: Mineral-surfaced cap sheets shall be cemented to the roofing plies using no less cementing material than specified for between the plies.

780 CMR 3609.8 WOOD SHINGLES

3609.8.1 Sheathing requirements: Wood shingles shall be applied to roofs with solid or spaced sheathing. Spaced sheathing boards shall not be less than one inch by four inch (25 mm by 102 mm) nominal dimensions and shall be spaced on centers a distance equal to the actual weather exposure of the shingles, not to exceed the dimensions set forth in Table *3609.8 3.3*.

3609.8.2 Materials: Wood shingle roofing shall conform to CSSB "Grading and Packing Rules for Centigrade Red Cedar Shingles," ***as listed in Appendix A***.

3609.8.3 Installation: Wood shingles shall be laid with a side lap of not less than 1½ inches (38 mm). Joints in adjacent courses shall be offset a minimum of 1½ inches (38 mm) and no two joints in alternate courses shall be in direct alignment. Spacing between shingles shall not be less than ¼ inch (6.4 mm) or more than ⅜ inch (9.5 mm). Wood shingles shall be fastened to the sheathing in accordance with Table *3609.8.3*.

3609.8.3.1 Roof slope: Shingles shall not be installed on a roof having a slope less than three units vertical in 12 units horizontal (25% slope) On roofs having slopes of three units vertical in 12 units horizontal (25% slope) to less than four units vertical in 12 units horizontal (33% slope), shingles shall be installed with reduced exposures or they shall be installed over an underlayment of not less than one ply of No. 15 felt, applied as required in ***780 CMR 3609.2***.

3609.8.3.2 Valley flashing: Roof valley flashing shall not be less than No. 28 gage corrosion-resistant sheet metal and shall extend ten inches (254 mm) from the center line each way for roofs having slopes less than 12 units vertical in 12 units horizontal (100% slope) and seven inches (178 mm) from the center line each way for slopes of 12 units vertical in 12 units horizontal (100%) slope) and greater. Sections of flashing shall have an end lap of not less than four inches (102 mm).

3609.8.3.3 Weather exposure: Weather exposures shall not exceed those set forth in Table ***3609.8.3.3.*** Hip and ridge weather exposures shall not exceed those permitted for the field of the roof. Wood shingle hip and ridge units shall conform to CSSB "Grading Rules for Shake Hip and Ridge based on the Standards of the Cedar Shake and Shingle Bureau," ***as listed in Appendix A***. Nails used to fasten hip and ridge units shall be longer than those used in the field of the roof in order to penetrate the sheathing ¾-inch (19 mm) minimum.

3609.8.3.4 Label required: Each bundle of shingles shall be identified by a label of an approved grading or inspection bureau or agency.

780 CMR 3609.9 WOOD SHAKES

3609.9.1 Sheathing requirements: Wood shakes shall be applied to roofs with solid or spaced sheathing. Spaced sheathing boards shall not be less than one-inch-by-four-inch (25 mm by 102 mm) nominal dimensions for shakes installed at maximum 7½-inch (190 mm) exposures and shall be spaced on centers a distance equal to the actual weather exposure of the shakes, not to exceed the dimensions set forth in Table ***3609.8.3.3***. For 24-inch (610 mm) shakes used in ten-inch (254 mm) exposure, the spaced sheathing shall be either one-inch-by-four-inch (25 mm by 102 mm) nominal dimension board spaced on centers a distance equal to the weather exposure with an additional one-inch-by-four-inch (25 mm by 102 mm) board placed between these boards, or one-inch-by-six-inch (25 mm by 153 mm) nominal dimension boards spaced on centers a distance equal to the weather exposure. The shakes shall be applied over an underlayment as required in Table *3609.8.3*.

TABLE 3609.8.3
WOOD SHINGLE OR SHAKE APPLICATION

ROOF SLOPE	**WOOD SHINGLES** **Not permitted below 3:12** **See Table 3609.8.3.3**	**WOOD SHAKES** **Not permitted below 4:12[1]** **See Table 3609.8.3.3**
DECK REQUIREMENT	Wood shingles shall be applied to roofs having solid or spaced sheathing in accordance with 780 CMR 3609.8.1	Wood shakes shall be applied to roofs having solid or spaced sheathing in accordance with 780 CMR 3609.9.1
UNDERLAYMENT Temperate climate	No Requirements	One 18-inch-wide interlayment of Type 30 felt shingled between each course in such a manner that no felt is exposed to the weather below the shake butts.
Severe climate: In areas subject to roof ice buildup.	Two layers of nonperforated Type 15 felt applied shingle fashion shall be installed and solid cemented together with approved cementing material between the plies extending from the eaves to a line 36 inches inside the exterior wall line of the building.	Sheathing shall be solid and the shakes shall be applied over a layer of nonperforated Type 15 felt applied shingle fashion. Two layers of nonperforated Type 15 felt applied shingle fashion shall be installed and solid cemented together with approved cementing material between the plies extending from the eaves up the roof to a line 36 inches inside the exterior wall line of the building.
ATTACHMENT Type of fasteners	Corrosion-resistant nails, minimum No. 14 ½-gage, $^{7}/_{32}$-inch head, or corrosion-resistant staples when approved by the building official.	Corrosion-resistant nails, minimum No. 13-gage, $^{7}/_{32}$-inch head, or corrosion-resistant staples when approved by the building official.
	Fasteners shall be long enough to penetrate into the sheathing ¾ inch or through the thickness of the sheathing, whichever is less.	
No. of fasteners	two per shingle	two per shake
Exposure Field of roof Hips and ridges	Weather exposures shall not exceed those set forth in Table 3609.8.3.3. Hip and ridge weather exposures shall not exceed those permitted for the field of the roof.	
Method	Shingles shall be laid with a side lap of not less than 1½ inches between joints in adjacent courses, and not in direct alignment in alternate courses. Spacing between shingles shall be approximately ¼ inch. Each shingle shall be fastened with two nails only, positioned approximately ¾ inch from each edge and approximately one inch above the exposure line. Starter course at the eaves shall be doubled.	Shakes shall be laid with a side lap of not less than 1½ inches between joints in adjacent courses. Spacing between shakes shall not be less than ⅛ inch or more than ⅝ inch except for preservative-treated wood shakes which shall have a spacing not less than ¼ inch or more than ⅜ inch. Shakes shall be fastened to the sheathing with two nails only, positioned approximately one inch from each edge and approximately two inches above the exposure line. The starter course at the eaves shall be doubled. The bottom or first layer may be either shakes or shingles. 15-inch or 18-inch shakes may be used for the starter course at the eaves and final course at the ridge.
FLASHINGS Valleys Other flashings	Per 780 CMR 3609.8.3.2 and 3609.9.3.3 Per accepted practice.	

For SI: 1 inch = 25.4 mm.

1. When approved by the building official, wood shakes may be installed on a slope of not less than three units vertical in 12 units horizontal (25% slope) when underlayment of not less than nonperforated Type 15 felt is installed.

TABLE 3609.8.3.3
WOOD SHINGLE AND SHAKE MAXIMUM WEATHER EXPOSURES

GRADE	LENGTH (inches)	LESS THAN 4" IN 12" (inches) (Minimum 3" in 12" Permitted)	4" IN 12" AND STEEPER (inches)
		WOOD SHINGLES	
No. 1	16	3¾	5
No. 2[1]	16	3½	4
No. 3[1]	16	3	3½
No. 1	18	4¼	5½
No. 2[1]	18	4	4½
No. 3[1]	18	3½	4
No. 1	24	5¾	7½
No. 2[1]	24	5½	6½
No. 3[1]	24	5	5½
		WOOD SHAKES[2]	
No. 1	18	7½	7½
No. 2	18[3]	Not Permitted	5½
No. 1	24	10	10
No. 2	24[3]	Not Permitted	7½

For SI: 1 inch = 25.4 mm.

1. To be used only when specifically permitted by the building official.
2. Exposure of 24-inch resawn handsplit shakes shall not exceed 7½ inches regardless of the roof slope.
3. No. 2 grade wood shakes pertain to Taper-sawn shakes only.

3609.9.2 Materials: Wood shake shall conform to CSSB "Grading and Packing Rules for Certi-Split Red Cedar Shakes" or "Grading Rules for Certi-Sawn Taper-Sawn Cedar Shakes," ***each as listed in Appendix A.***

3609.9.3 Installation: Preservative treated wood shakes shall conform to CSSB "Wood Shakes (Preservative Treated) based on Grading and Packing Rules for Treated Southern Pine Taper Sawn Shakes of the Cedar Shake and Shingle Bureau," ***as listed in Appendix A***. Wood shakes shall be fastened to the sheathing in accordance with Table ***3609.8.3***.

3609.9.3.1 Shake and shingle placement: The starter course at the eaves shall be doubled and the bottom layer shall be either 15-, 18- or 24-inch (381, 457 or 610 mm) wood shakes or wood shingles. Fifteen-inch (381 mm) or 18-inch (457 mm) wood shakes may be used for the final course at the ridge. Shakes shall be interlaid with 18-inch-wide (451 mm) strips of not less than No. 30 felt shingled between each course in such a manner that no felt is exposed to the weather by positioning the lower edge of each felt strip above the butt end of the shake it covers a distance equal to twice the weather exposure.

3609.9.3.2 Roof slope: Shakes shall not be installed on a roof having a slope less than four units vertical in 12 units horizontal (33% slope) unless they are installed over an underlayment of not less than No. 15 felt, applied as required in *780 CMR 3609.2*.

3609.9.3.3 Valley flashing: Roof valley flashing shall not be less than No. 28 gage corrosion-resistant sheet metal and shall extend at least 11 inches (279 mm) from the center line each way. Sections of flashing shall have an end lap of not less than four inches (102 mm).

3609.9.3.4 Weather exposure: Weather exposures shall not exceed those set forth in Table *3609.8.3.3*. Hip and ridge weather exposures shall not exceed those permitted for the field of the roof. Wood shake hip and ridge units shall conform to CSSB "Grading Rules for Shake Hip and Ridge based on the Standards of the Cedar Shake and Shingle Bureau," ***as listed in Appendix A***. Nails used to fasten hip and ridge units shall be longer than those used in the field of the roof in order to penetrate the sheathing ¾ inch (19 mm) minimum.

3609.9.3.5 Label Required: Each bundle of shakes shall be identified by a label of an approved grading or inspection bureau or agency.

780 CMR 3609.10 REROOFING

3609.10.1 General: Materials and methods used for repair, replacement or recovering an existing roof shall comply with ***780 CMR 3601.17 and 3609.1.1***. When the repair replacement or recovering within any 12-month period exceeds 25% of the roof covering of the building, the entire roof covering shall comply with the requirements for new roofing.

3609.10.2 Structural and construction loads: The existing roof system shall be capable of supporting all equipment loads encountered during installation as well as the loads resulting from the new roofing materials.

3609.10.3 Recovering vs. replacement: New roof covering shall not be installed without first removing existing roof coverings when any of the following conditions occur:

1. When the existing roof or roof covering is water soaked or deteriorated to the point of being unacceptable as a base for additional roofing.
2. When the existing roof covering is wood shake, slate, clay or cement tile; except when the new roof covering is installed in accordance with approved industry standards.
3. When the existing roof has two or more layers of any type of roofing.

Exception: The removal of existing roof coverings shall not be required where complete and separate roofing systems are provided which transmit all roof loads directly to the structural system of the building and which do not bear upon the existing roof.

3609.10.4 Reinstallation of materials: The reinstallation of existing or damaged wood or asphalt roof covering materials which have been removed is not permitted.

3609.10.5 Flashings: Flashings shall be reconstructed in accordance with approved manufacturer's instruction.

NON-TEXT PAGE

780 CMR 3610

CHIMNEYS, FIREPLACES AND SOLID FUEL-FIRED APPLIANCES

3610.1 GENERAL

3610.1.1 Scope: The provisions of 780 CMR 3610 shall control the design, construction, listing and/or installation of chimneys, fireplaces and solid fuel-fired appliances in one- and two-family buildings.

3610.2 Masonry chimneys, general: Masonry chimneys shall be constructed, anchored, supported and reinforced as required in 780 CMR 3610 and the applicable provisions of 780 CMR 3603, 3604 and 3606. Chimneys shall be structurally sound, durable, smoke tight and capable of conveying flue gases to the exterior safely.

Chimneys in wood-frame buildings, shall, at a minimum, be anchored laterally at the ceiling lines and at each floor line which is more than six feet above grade except when entirely within the framework of the building. Anchors, bolts, and straps so utilized shall be listed for such use and utilized in accordance with their listing.

3610.2.1 Support: Masonry chimneys shall be supported on foundations of solid masonry or concrete at least 12 inches (305 mm) thick and at least six inches (153 mm) beyond each side of the exterior dimensions of the chimney. Footings shall be founded on natural undisturbed earth below frostline. In areas not subject to freezing, footings shall be located a minimum of 12 inches (305 mm) below finished grade.

3610.2.2 Corbeling: Masonry chimneys shall not be corbeled more than six inches (153 mm) from a wall or foundation, nor shall a chimney be corbeled from a wall or foundation which is less than 12 inches (305 mm) in thickness unless it projects equally on each side of the wall, except that on the second story of a two-story dwelling, corbeling of chimneys on the exterior of the enclosing walls may equal the wall thickness. The projection of a single course shall not exceed one-half the unit height or one third of the unit bed depth, whichever is less.

3610.2.3 Changes in dimension: The chimney wall or chimney flue lining shall not change in size or shape within six inches (153 mm) above or below where the chimney passes through floor components, ceiling components or roof components.

3610.2.4 Additional load: Chimneys shall not support loads other than their own weight unless they are designed and constructed to support the additional load.

3610.2.5 Termination: Chimneys shall extend at least two feet (610 mm) higher than any portion of the building within ten feet (3048 mm), but shall not be less than three feet (914 mm) above the point where the chimney passes through the roof.

3610.2.6 Wall thickness: Masonry chimney walls shall be constructed of solid masonry units with not less than four inches (102 mm) nominal thickness.

3610.2.7 Flue lining (material): All masonry chimneys shall be lined with fireclay flue liners not less than ⅝ inch (15.9 mm) in thickness or with other approved liner of material that will resist, without cracking or softening, a temperature of 1,800°F (982°C).

Note: Lined masonry chimneys may require additional metal liners when such chimneys convey the exhaust products of gas-fired or oil-fired appliances - refer also to 248 CMR or 527 CMR as applicable.

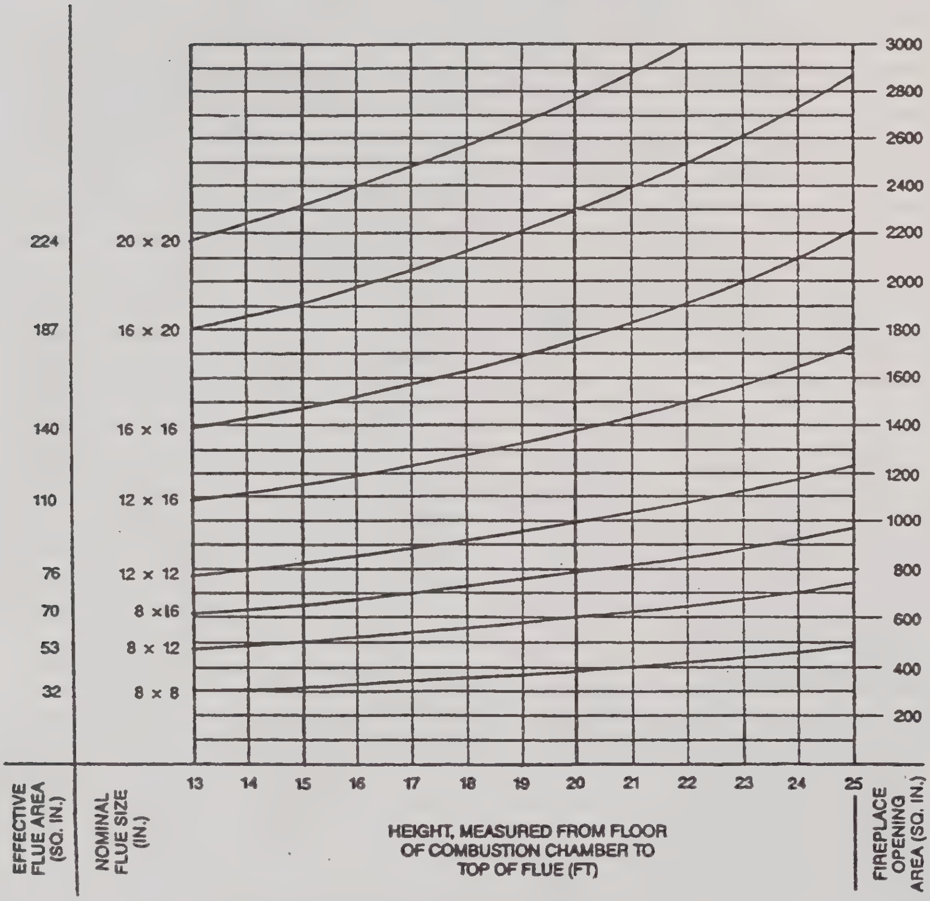
3610.2.8 Flue lining (installation): Flue liners shall extend from a point not less than eight inches (203 mm) below the lowest inlet or as otherwise required by 248 CMR or 527 CMR if applicable, or, in the case of fireplaces, from the top of the smoke chamber, to a point above the enclosing walls. Fireclay flue liners shall be laid with tight mortar joints left smooth on the inside and installed to maintain a ½-inch-wide (12.7 mm) air space separating the flue liners from the interior face of the chimney masonry walls. Flue lining shall be supported on all sides.

3610.2.9 Multiple flues: When two or more flues are located in the same chimney, masonry wythes shall be built between adjacent flue linings. The masonry wythes shall be at least four inches (102 mm) thick and bonded into the walls of the chimney.

Exception: When venting only one appliance, two flues may adjoin each other in the same chimney with only the flue lining separation between them. The joints of the adjacent flue linings shall be staggered at least seven inches (178 mm).

3610.2.10 Flue area (appliance): Chimney flues shall not be smaller in area than that of the area of the connector from the appliance. The sizing and installation of a chimney flue to which multiple-appliance venting systems are connected shall be in accordance with 780 CMR 3621.

Figure 3610.2.11
FLUE SIZES FOR MASONRY CHIMNEYS[1]



For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 square inch = 645.16 mm^2.

[1] When using figure 3610.2.11, select the smaller flue size when the opening and height selected for the fireplace and chimney, respectively, intersect between standard flue sizes.

3610.2.11 Flue area (masonry fireplace): The cross-sectional area of the chimney flue shall be determined in accordance with Figure 3610.2.11. For square or rectangular flues, the nominal flue size shown or a size providing equivalent cross-sectional area shall be used. For round flues, the size selected shall be at least equal to the effective flue area determined in accordance with Figure 3610.2.11. The height of the chimney shall be measured from the firebox floor to the top of the last chimney flue tile. Individual flue tiles shall not have a cross-sectional area less than 50 square inches (0.032 m^2) for round flues or 64 square inches (0.041 m^2) for square or rectangular flues. Unlined chimneys shall have a minimum cross-sectional area of 100 square inches (0.064 m^2).

3610.2.12 Inlet: Inlets to masonry chimneys shall enter from the side. Inlets shall have a thimble of fireclay, rigid refractory material or metal that will prevent the connector from pulling out of the inlet or from extending beyond the wall of the liner.

3610.2.13 Masonry chimney cleanout openings: Cleanout openings shall be provided within six inches (153 mm) of the base of every masonry chimney.

Exception: Chimneys serving masonry fireplaces.

3610.2.14 Chimney clearances: A portion of a masonry chimney located in the interior of the building or within the exterior wall of the building shall have a minimum air space clearance to combustibles of two inches (51 mm). Chimneys located entirely outside the exterior walls of the building, are permitted to have combustible material in contact with the chimney exterior surfaces. Masonry chimneys equipped with a chimney lining system listed and labeled for use in chimneys in contact with combustibles in accordance with UL 1777, and installed in accordance with the manufacturer's installation instructions, are permitted to have combustible material in contact with their exterior surfaces.

The requirements of 780 CMR 3610.2.14 shall not eliminate the requirement for noncombustible firestopping in accordance with 780 CMR 3610.2.15.

3610.2.15 Chimney firestopping: See 780 CMR 3606.2.7.

3610.2.16 Chimney crickets Chimney shall be provided with crickets when the dimension parallel to the ridgeline is greater than 30 inches (762 mm) and does not intersect the ridgeline. The intersection of the cricket and the chimney shall be flashed and counterflashed in the same manner as normal roof-chimney intersections. Crickets shall be constructed in conformity with Figure 3610.2.16 and Table 3610.2.16.

Figure 3610.2.16
CHIMNEY CRICKET

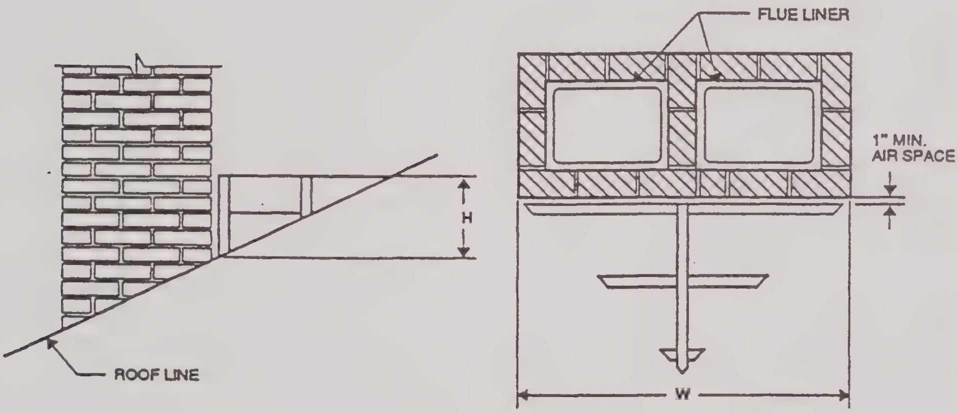


Table 3610.2.16
CRICKET DIMENSIONS

ROOF SLOPE	H
12 - 12	1/2 of W
8 - 12	1/3 of W
6 - 12	1/4 of W
4 - 12	1/6 of W
3 - 12	1/8 of W

3610.3 Factory-built chimneys, general: Factory-built chimneys shall be tested and listed to UL-103 or CAN/ULC-S629-M87 as found in **Appendix A** and shall be installed, operated and maintained in accordance with the conditions of their listing and the manufacturer's requirements. Factory-built chimneys that are listed as part of an assembly with factory-built fireplaces shall conform to 780 CMR 3610.5.1.

3610.4 Masonry fireplaces, general: Masonry fireplaces shall conform to the requirements of 780 CMR 3610.4.1 through 3610.4.7.

Note: Masonry fireplaces may be prescriptively constructed or may be of the "Rumford" type or may be of contemporary design; refer, additionally to the BOCA National Mechanical Code; Brick Institute of America, Technical Notes and NFPA 211 as listed in *Appendix A* - also see Figures 3610.4.1a, 1b, 1c, 1d,. 1e, 1f and 1g.

3610.4.1 Fireplace support: Fireplace foundations and supporting walls shall be anchored, supported and reinforced as required in 780 CMR 3610.4.1 through 3610.4.7, Table 3610.4.1, Figure 3610.4.1a and the applicable provisions of 780 CMR 3603 and 3604.

Exception: Masonry fireplaces other than those that are prescriptively constructed shall comply with the requirements of 780 CMR 3610.4.1 through 3610.4.7 but may be of a design other than shown in Figure 3610.4.1a - also see Figures 3610.4.1b, 1c, 1d,. 1e, 1f and 1g.

Foundations for masonry fireplaces and their chimneys shall be constructed of concrete or solid masonry at least 12 inches (305 mm) thick and extend at least six inches (153 mm) beyond the face of the fireplace or supporting wall on all sides. Footings shall be founded on natural undisturbed earth or engineered fill below frost depth. In areas not subjected to freezing, footings shall be at least 12 inches (305 mm) below finished grade.

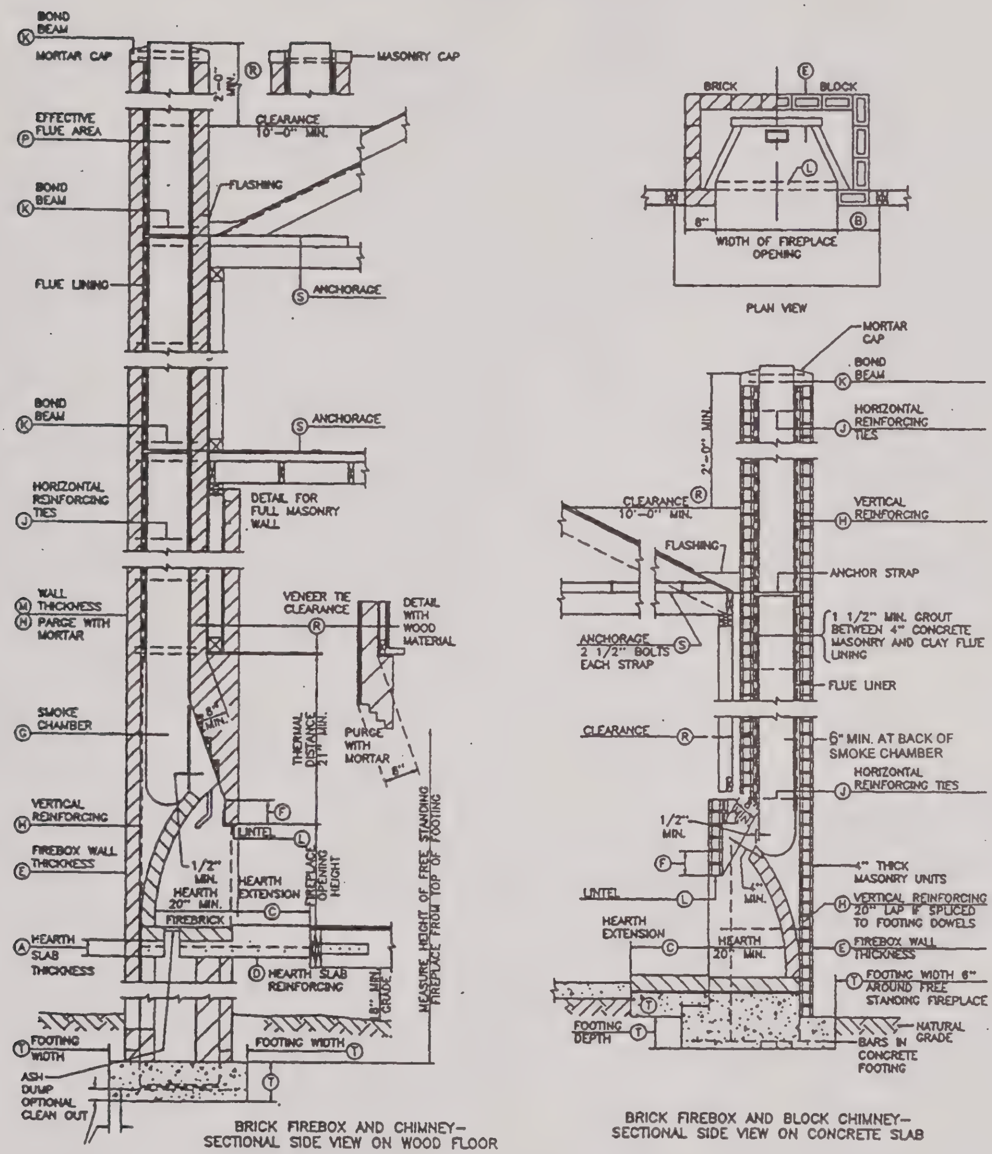
Table 3610.4.1
REQUIREMENTS FOR MASONRY FIREPLACES AND CHIMNEYS

ITEM	LETTER[1]	REQUIREMENTS
Hearth slab thickness	A	4"
Hearth extension (each side of opening)	B	8" fireplace opening < 6 sq. ft. 12" fireplace opening ≥ 6 sq. ft.
Hearth extension (front of opening)	C	16" fireplace opening < 6 sq. ft. 20" fireplace opening ≥ 6 sq. ft
Hearth slab reinforcing	D	Reinforced as necessary to carry its own weight and all imposed loads
Thickness of wall of firebox	E	12" solid brick or 8" where a firebrick lining is used. Joints in firebrick 1/4" max.
Distance from top of opening to throat	F	8"
Smoke chamber edge of shelf Rear wall - thickness Front wall - thickness	G	 6" 8"
Chimney Vertical reinforcing	-	Seismic load reinforcement not required in Massachusetts
Horizontal reinforcing	-	Seismic load reinforcement not required in Massachusetts
Bond beams	K	No specified requirements
Fireplace lintel	L	Noncombustible material
Walls with flue lining	M	Refer to 780 CMR 3610.2.8
Walls with unlined flue	N	Unlined chimneys are not allowed to be constructed in Massachusetts
Distances between adjacent flues	-	Refer to 780 CMR 3610.2..9
Effective flue area (based on area of fireplace opening)	P	Refer to 780 CMR 3610.2.10 and 3610.2.11
Clearances Wood frame and combustible material Above roof	R	 Refer to 780 CMR 3610.2.14 and 3610.4.7 2' at 10' (780 CMR 3610.2.5)
Anchorage	-	Refer to 780 CMR 3610.4.1 and Figure 3610.4.1a
Footing Thickness Width	T	 12" min. 6" each side of fireplace wall

For SI: 1 inch = 304.8 mm.

1. The letters in this column refer to Figure 3610.4.1a

Figure 3610.4.1a
FIREPLACE AND CHIMNEY DETAILS


Ⓚ BOND BEAM
MORTAR CAP
2" MIN.
Ⓡ
MASONRY CAP
Ⓟ EFFECTIVE FLUE AREA
CLEARANCE 10'-0" MIN.
Ⓚ BOND BEAM
FLASHING
FLUE LINING
Ⓢ ANCHORAGE
Ⓚ BOND BEAM
Ⓢ ANCHORAGE
Ⓙ HORIZONTAL REINFORCING TIES
DETAIL FOR FULL MASONRY WALL
Ⓜ WALL THICKNESS
Ⓝ PARGE WITH MORTAR
VENEER TIE CLEARANCE Ⓡ
DETAIL WITH WOOD MATERIAL
Ⓖ SMOKE CHAMBER
8" MIN.
THERMAL DISTANCE 2" MIN.
PURGE WITH MORTAR
8"
Ⓗ VERTICAL REINFORCING
Ⓕ
LINTEL Ⓛ
Ⓔ FIREBOX WALL THICKNESS
1/2" MIN.
HEARTH 20" MIN.
HEARTH EXTENSION Ⓒ
FIREPLACE OPENING HEIGHT
MEASURE HEIGHT OF FREE STANDING FIREPLACE FROM TOP OF FOOTING
FIREBRICK
Ⓐ HEARTH SLAB THICKNESS
Ⓓ HEARTH SLAB REINFORCING
6" MIN. GRADE
Ⓣ FOOTING WIDTH
FOOTING WIDTH Ⓣ
Ⓣ
ASH DUMP OPTIONAL CLEAN OUT
BRICK
Ⓔ
BLOCK
Ⓛ
8"
Ⓑ
WIDTH OF FIREPLACE OPENING
MORTAR CAP
Ⓚ BOND BEAM
2'-0" MIN.
Ⓙ HORIZONTAL REINFORCING TIES
CLEARANCE Ⓡ 10'-0" MIN.
Ⓗ VERTICAL REINFORCING
FLASHING
ANCHOR STRAP
ANCHORAGE 2 1/2" BOLTS EACH STRAP Ⓢ
1 1/2" MIN. GROUT BETWEEN 4" CONCRETE MASONRY AND CLAY FLUE LINING
FLUE LINER
CLEARANCE Ⓡ
6" MIN. AT BACK OF SMOKE CHAMBER
Ⓙ HORIZONTAL REINFORCING TIES
1/2" MIN.
Ⓕ
4" THICK MASONRY UNITS
4" MIN.
LINTEL Ⓛ
Ⓗ VERTICAL REINFORCING 20" LAP IF SPLICED TO FOOTING DOWELS
HEARTH EXTENSION Ⓒ
HEARTH 20" MIN.
Ⓔ FIREBOX WALL THICKNESS
Ⓣ FOOTING WIDTH 6" AROUND FREE STANDING FIREPLACE
Ⓣ
FOOTING DEPTH Ⓣ
NATURAL GRADE
BARS IN CONCRETE FOOTING

PLAN VIEW

BRICK FIREBOX AND CHIMNEY—SECTIONAL SIDE VIEW ON WOOD FLOOR

BRICK FIREBOX AND BLOCK CHIMNEY—SECTIONAL SIDE VIEW ON CONCRETE SLAB

Figures 3610.4.1b through 3610.4.1g
TYPICAL FIREPLACE DETAILS

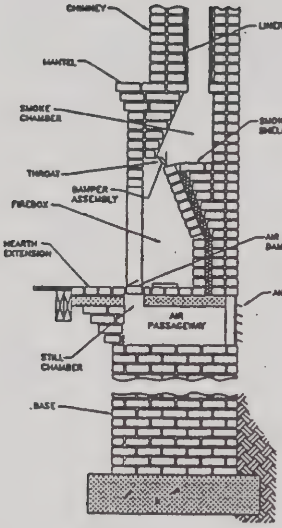

CHIMNEY
LINER
MANTEL
SMOKE CHAMBER
SMOKE SHELF
THROAT
DAMPER ASSEMBLY
FIREBOX
AIR INLET DAMPER
HEARTH EXTENSION
AIR INTAKE
AIR PASSAGEWAY
STILL CHAMBER
BASE

Figure 3610.4.1b
SINGLE-FACE FIREPLACE SECTION

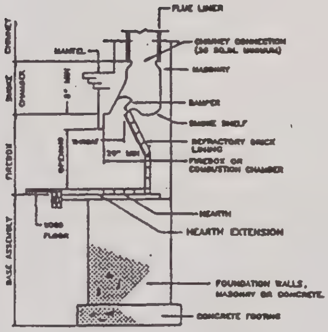

FLUE LINER
CHIMNEY
CHIMNEY CONNECTION (30 SQ.IN. MINIMUM)
MANTEL
MASONRY
SMOKE CHAMBER
8" MIN
DAMPER
SMOKE SHELF
THROAT
REFRACTORY BRICK LINING
20" MIN
OPENING
FIREBOX
FIREBOX OR COMBUSTION CHAMBER
HEARTH
WOOD FLOOR
HEARTH EXTENSION
BASE ASSEMBLY
FOUNDATION WALLS, MASONRY OR CONCRETE
CONCRETE FOOTING

Figure 3610.4.1e
SECTION THROUGH FIREPLACE

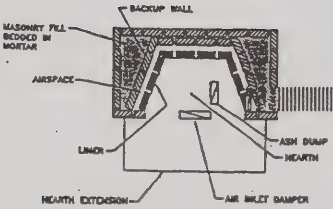

BACKUP WALL
MASONRY FILL BEDDED IN MORTAR
AIRSPACE
LINER
ASH DUMP
HEARTH
HEARTH EXTENSION
AIR INLET DAMPER

Figure 3610.4.1c
SINGLE-FACES FIREPLACE PLAN

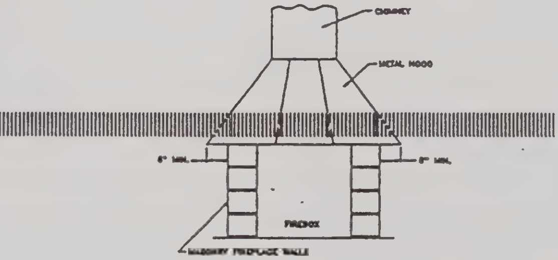

CHIMNEY
METAL HOOD
8" MIN.
8" MIN.
FIREBOX
MASONRY FIREPLACE WALLS

Figure 3610.4.1f
FRONT VIEW OF METAL HOOD OVERHANG

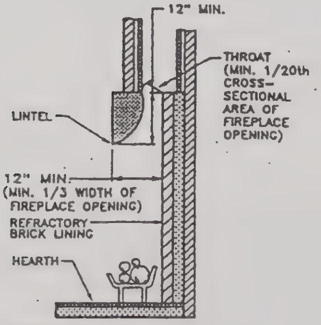

12" MIN.
THROAT (MIN. 1/20th CROSS-SECTIONAL AREA OF FIREPLACE OPENING)
LINTEL
12" MIN. (MIN. 1/3 WIDTH OF FIREPLACE OPENING)
REFRACTORY BRICK LINING
HEARTH

Figure 310.4.1d
RUMFORD REQUIREMENTS

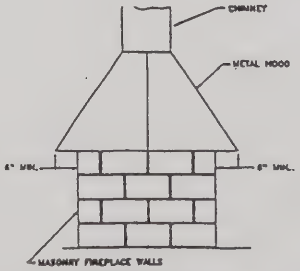

CHIMNEY
METAL HOOD
8" MIN.
8" MIN.
MASONRY FIREPLACE WALLS

Figure 3610.4.1g
SIDE VIEW OF METAL HOOD OVERHANG

3610.4.2 Seismic reinforcing: Not applicable in Massachusetts.

3610.4.2.1 Seismic anchorage: Not applicable in Massachusetts.

3610.4.3 Fireplace walls: Masonry fireplaces shall be constructed of solid masonry units, stone or reinforced concrete in accordance with Figure 3610.4.1a. When a lining of firebrick at least two inches (51 mm) in thickness is provided, the total thickness of back and sides, including the lining, shall not be less than eight inches (203 mm). When no lining is provided, the thickness of back and sides shall not be less than 12 inches (305 mm).

3610.4.3.1 Walls, steel fireplace units: Steel fireplace units shall be listed in accordance with UL 127 as found in ***Appendix A*** and shall be installed, operated and maintained according to their listing, the manufacturer's requirements and any applicable requirements of 780 CMR. Such fireplaces incorporating a fire box liner of not less than ¼ inch (6.4 mm) in thickness and an air chamber, may be installed with masonry to provide a total thickness at the back and sides of not less than eight inches (203 mm), of which not less than four inches (102 mm) shall be of solid masonry. Warm-air ducts employed with steel fireplace units of the circulating air type shall be constructed of metal or masonry.

3610.4.4 Lintel: Masonry over a fireplace opening shall be supported by a lintel of noncombustible material. The minimum required bearing length on each end of the fireplace opening shall be four inches (102 mm).

3610.4.5 Hearth extension material: Hearth extensions shall be of masonry or concrete at least four inches (102 mm) thick and supported by noncombustible materials and reinforced to carry its own weight and all imposed loads. The hearth extension shall be readily distinguishable from the surrounding floor. Combustible forms and centers used during the construction of the hearth extension shall be removed after the construction is complete.

Exception: When the bottom of the firebox opening is raised at least eight inches (203 mm) above the top of the hearth extension, a hearth extension of not less than ⅜ inch-thick (9.5I mm) brick, concrete, stone, tile or other approved noncombustible material may be used.

3610.4.6 Hearth extension: The hearth and the hearth extension shall extend a minimum of 36 inches (914 mm) from the back of the firebox to the end of the hearth extension. Hearth extensions shall extend at least 16 inches (406 mm) in front of, and at least eight inches (203 mm) beyond, each side of the fireplace opening. Where the fireplace opening is six square feet (0.557 m2) or larger, the hearth extension shall extend at least 20 inches (508 mm) in front of, and at least 12 inches (305 mm) beyond, each side of the fireplace opening.

3610.4.7 Fireplace clearance (also see Figures 3610.4.7a and 7b):

1. Fireplaces - the exterior surface of fireplace walls shall have a minimum of four inches (102mm) clearance to combustibles.
2. Fireplaces - combustible materials attached to a fireplace face, such as trim and mantels, shall have a minimum clearance of six inches (152 mm) from a fireplace opening.
3. Fireplaces - combustible materials above and projecting more than 1½ inches (38mm) from a fireplace face shall have a minimum clearance of 12 inches (305mm) above a fireplace opening.

Note: For chimney clearances to combustibles, see 780 CMR 3610.2.14

Figure 3610.4.7a
CONSTRUCTION REQUIREMENTS FOR A TYPICAL MASONRY FIREPLACE IN A WOOD FRAME WALL

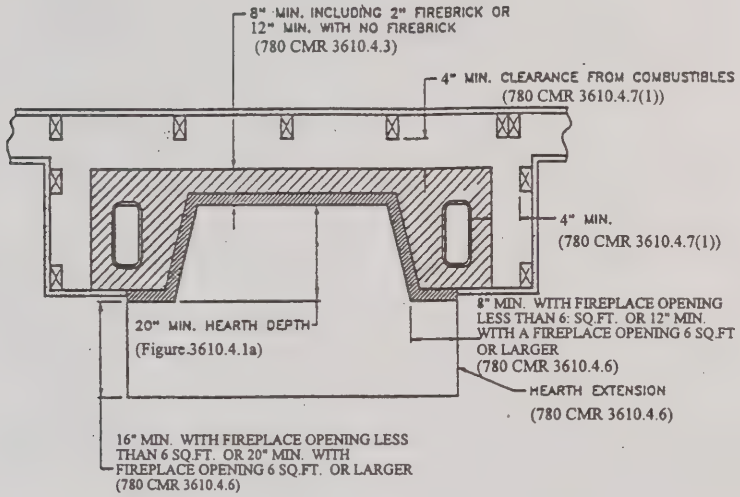
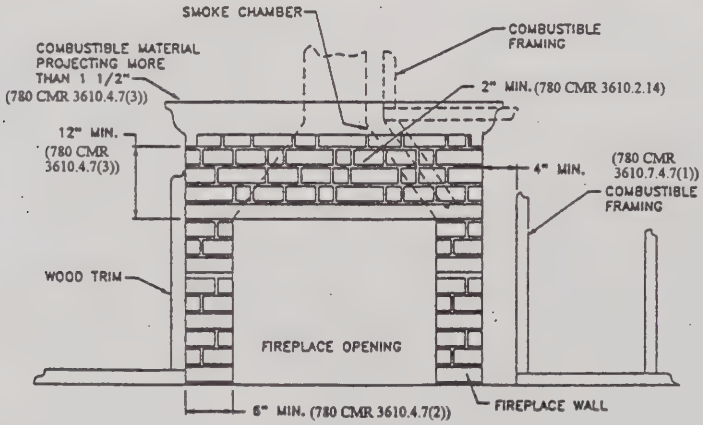

8" MIN. INCLUDING 2" FIREBRICK OR 12" MIN. WITH NO FIREBRICK (780 CMR 3610.4.3)
4" MIN. CLEARANCE FROM COMBUSTIBLES (780 CMR 3610.4.7(1))
4" MIN. (780 CMR 3610.4.7(1))
20" MIN. HEARTH DEPTH (Figure 3610.4.1a)
8" MIN. WITH FIREPLACE OPENING LESS THAN 6: SQ.FT. OR 12" MIN. WITH A FIREPLACE OPENING 6 SQ.FT OR LARGER (780 CMR 3610.4.6)
HEARTH EXTENSION (780 CMR 3610.4.6)
16" MIN. WITH FIREPLACE OPENING LESS THAN 6 SQ.FT. OR 20" MIN. WITH FIREPLACE OPENING 6 SQ.FT. OR LARGER (780 CMR 3610.4.6)

Figure 3610.4.7b
REQUIRED CLEARANCES FROM MASONRY FIREPLACE TO COMBUSTIBLES


SMOKE CHAMBER
COMBUSTIBLE FRAMING
COMBUSTIBLE MATERIAL PROJECTING MORE THAN 1 1/2" (780 CMR 3610.4.7(3))
2" MIN. (780 CMR 3610.2.14)
12" MIN. (780 CMR 3610.4.7(3))
4" MIN.
(780 CMR 3610.7.4.7(1))
COMBUSTIBLE FRAMING
WOOD TRIM
FIREPLACE OPENING
6" MIN. (780 CMR 3610.4.7(2))
FIREPLACE WALL

3610.5 Factory-built fireplaces, general: Factory-built fireplaces shall conform to the requirements of 780 CMR 3610.5.1 through 3610.5.4.

3610.5.1 Installation: Factory-built fireplaces that consist of a fire chamber assembly, one or more chimney sections, a roof assembly and other parts shall be tested and listed to UL-127 as found in ***Appendix A***. Such fireplaces may be installed when complying with all the following provisions:

1. The fire chamber assembly is installed to provide clear clearance to combustible materials not less than set forth in the listing.
2. The chimney sections are installed to provide clearance to combustible material not less than specified in the listing and if the fireplace chimney extends through floors and ceilings, factory-furnished firestops or firestop spacers shall be installed. Portions of chimneys which extend through rooms or closets are to be enclosed to avoid personal contact, contact of combustible material, and damage to the chimney.
3. Hearth extensions shall not be less than ⅜-inch-thick (9.5 mm) millboard, hollow metal, stone, tile or other approved noncombustible material. Such hearth extensions may be placed on combustible subflooring or finish flooring. The hearth extension shall be readily distinguished from the surrounding floor.

Note: Where *floor protection* underneath, to the sides, back or in front of factory-built fireplaces is required via testing/listing and/or manufacturer's requirments, refer to *floor protector* requirements of 780 CMR 3610.6.7.1 and 3610.6,7,1,1.

4. Hearth extensions shall extend not less than 16 inches (406 mm) in front of and at least eight inches (203 mm) beyond both sides of the fireplace opening.

Exception: Where tested/listed extensions are identified, such hearth extension shall be allowed and required.

5. Factory-built fireplaces shall be installed in accordance with their listing and the manufacturer's installation instructions.

6. The supporting structure for a hearth extension shall be at the same level as the supporting structure for the fire place unit unless otherwise authorized by the listing.

3610.6 Solid fuel burning appliances

3610.6.1 Solid fuel-fired appliances, general: Solid fuel-fired appliances employed for comfort heating include, but are not limited to, room heaters and stoves, fireplace inserts, furnaces and boilers; additionally, the fuel for such appliances includes, but is not limited to: wood and wood pellets, coal and various other solid fuels such as nut shells and corn, etc. Solid fuel-burning appliances shall be tested and listed by *approved agencies* and installed, operated and maintained in accordance with such listing, the manufacturers' requirements and otherwise conform to the requirements of 780 CMR 3610.6.

Note 1: No solid fuel-burning appliance shall be installed in Massachusetts unless such appliance conforms to all applicable requirements of 780 CMR 3610.6, including the testing and listing of all clearances to combustibles and identification of required floor protection.

Note 2: In the absence of explicit requirements of 780 CMR 3610.6, the applicable requirements of NFPA 211 and/or the BOCA National Mechanical Code, as listed in ***Appendix A***, shall apply.

3610.6.1.1 Listing standards, Room heaters, stoves and fireplace inserts: Room heaters, stoves and fireplace stoves (inserts), employed for comfort heating shall be listed and tested to UL 1482 and/or ANSI/UL 737 as found in ***Appendix A*** and as applicable; all such appliances shall bear labeling as required in 780 CMR 3610.6.2 or 3610.6.3 as applicable.

3610.6.1.2 Listing standards, all pellet fueled solid fuel-burning appliances: All pellet solid fuel-burning appliances sold for use in Massachusetts shall conform to 780 CMR 3610.6.1.1 and additionally comply with the certification program set forth by the State Board of Building Regulations and Standards (for pellet appliance certification information, contact the State Board of Building Regulations and Standards).

Note: Commencing January 1, 1998, all pellet solid fuel-burning appliances shall be tested and listed to ASTM E 1509 as found in Appendix A and shall bear such labeling as required in 780 CMR 3610.6.2

3610.6.2 Solid fuel-burning appliance labeling (not central heating appliances): Every solid fuel-burning appliance utilized for comfort heating shall bear a permanent and legible factory-applied label supplied to the manufacturer and controlled by *an approved testing agency;* such label shall contain the following information:

1. Manufacturer's name and trademark;
2. Model and/or identification number of the appliance;
3. Type(s) of fuel(s) approved;
4. Testing laboratory's name or trademark and location;
5. Date tested;
6. Clearances to combustibles
    - (a) Above top
    - (b) From front
    - (c) From back
    - (d) From sides
7. Floor protection
8. National test standard(s)
9. Label serial number

3610.6.3 Solid fuel-burning central heating appliance labeling: Every solid fuel-burning boiler or warm air furnace shall bear a permanent and legible factory-applied label supplied to the manufacturer and controlled by an approved testing agency; such label shall contain the following information:

1. Manufacturer's name and trademark;
2. Model and/or identification number of the appliance;
3. Type(s) of fuel(s) approved;
4. Testing laboratory's name or trademark and location;
5. Date tested;
6. Clearances to combustibles
    - (a) Above top
    - (b) From front
    - (c) From back
    - (d) From sides
7. Floor protection if applicable
8. National test standard(s)
9. Label serial number
10. Type of appliance (boiler or warm air furnace)
11. Every boiler, pressure vessel, or pressure relief device must be stamped in accordance with the requirements of the ASME Boiler and Pressure Vessel Code. ASME stamping shall also be required for boilers, pressure vessels

and pressure relief devices produced outside the United State of America. Where required by the ASME Boiler and Pressure Vessel Code, ASME stamping may be affixed directly to the appliance in lieu of on the data plate.

3610.6.3 Hazardous locations: Solid fuel-burning appliances shall not be installed in hazardous locations (any location considered to be a fire hazard for flammable vapors, dust, combustible fibers or other highly combustible substances).

Exception: solid fuel-fired appliances listed for such locations.

3610.6.4 Air for combustion and ventilation: Solid fuel-burning appliances shall be installed in a location and manner to assure satisfactory combustion of fuel, proper chimney draft and maintenance of safe operating temperatures. Combustion air may be obtained from interior spaces when the interior space containing the appliance has a volume, in cubic feet equal to one-twentieth (1/20) of the output Btu rating of all fuel-burning appliances in the space. When buildings are so tight as to preclude adequate infiltration, provisions shall be made to introduce outside air for combustion and ventilation.

3610.6..5 Chimney connection: All solid fuel-burning appliances shall be connected to chimneys in accordance with their listing, the manufacturer's requirements and the requirements of 780 CMR 36.

Exception: Solid fuel-burning appliances listed for exhaust vent termination other than through a chimney.

3610.6.5.1 Chimney connector clearance to combustibles: See 780 CMR Table 3610.6.5.1.

3610.6.5.2 Chimney flue size: For solid fuel-burning comfort heating appliances for one- and two family use, the cross-sectional area of the flue shall not be less than the cross-sectional area of the appliance flue collar. The cross-sectional area of the flue shall not be more than three times the cross-sectional area of the flue collar of the appliance.

Table 3610..6.5.1[1,2]
CHIMNEY AND/OR VENT CONNECTOR CLEARANCES TO COMBUSTIBLE MATERIALS/SOLID FUEL-BURNING APPLIANCES ONLY

Description of Appliance	Connector Type	Minimum Clearance (in)	Minimum Clearance (mm)
Residential-Type Appliances	Single-wall Metal Pipe Connector	18	457
Residential-Type Appliances	Type L Vent Piping Connector	9	229
Low-heat Appliances Boilers, Furnaces, Water Heaters	Single-wall Metal Pipe Connector	18	457
Medium-Heat Appliances	Single-wall Metal Pipe Connector	36	914
High-Heat Appliances	Masonry or Metal Connector	Note 3	Note 3

1. For greater detail and guidance, refer to NFPA 211, Section 6-5.
2. For Chimney Connectors tested and listed for other clearances to combustibles, such tested, listed clearances shall apply.
3. Clearances shall be based on engineering calculations and, good engineering practice - Refer to NFPA 211, Section 6-5

3610.6.6 Connection to masonry fireplaces: A solid fuel-burning appliance such as a stove or fireplace insert shall be permitted to use a masonry fireplace flue where the following conditions are met:

1. There is a connector that extends from the appliance to the flue liner;
2. The cross-sectional area of the flue is no more than three times the cross-sectional area of the flue collar of the appliance but never less than the appliance exhaust collar cross-sectional area;
3. If the appliance vents directly through the chimney wall above the smoke chamber of the fireplace, there shall be a noncombustible seal below the entry point of the connector, sealing the fireplace from the appliance;
4. The installation shall be such that the chimney system can be inspected and cleaned;
5. Means shall be provided to prevent dilution of combustion products in the chimney flue with air from the habitable space.

3610.6.7 Mounting (placing) of residential solid fuel-burning appliances: Residential type solid fuel-burning appliances shall be tested and listed by *approved agencies* and such appliances, when mounted (placed) on combustible or noncombustible materials, shall be installed in accordance with their listing and the manufacturer's requirements.

Exceptions: See NFPA 211, Section 9-5.1.1.1 (all such exceptions pertain to placing of such appliances on well supported concrete bases, concrete slabs, properly stabilized, noncombustible soils or on approved, noncombustible assemblies of two hour fire resistance with floors constructed of noncombustible materials).

3610.6.7.1 Floor protection: Floor protection shall satisfy all listing requirements.

3610.6.7.1.1 Floor protectors - definition: *Floor protectors* are noncombustible surfacing applied to the combustible or noncombustible floor area underneath and extending in front, to the sides and to the rear of a heat producing appliance. For purposes of 780 CMR 3610.6.7, *floor protectors* must be noncombustible and have the necessary thermal conductivity to satisfy the appliance tested/listing floor protection requirements.

Note 1: Refer to Appendix K for information on floor protector thermal conductivity calculations

Note 2: Various "hearth rugs", "mats", "tile board", "hearth board" and similar products, sold as floor protectors may be noncombustible but may not satisfy thermal conductivity requirements to comply with 780 CMR 3610.6.7.1.

3610.6.8 Appliance clearances: Solid fuel-burning appliances shall be installed in accordance with the manufacturer's tested, listed clearances (also see 780 CMR 3610.6.11.1 for *used* solid fuel-burning appliance clearance requirements).

3610.6.8.1 Clearance reductions: Tested, listed clearances to combustibles shall only be permitted to be reduced in accordance with the requirements of NFPA 211, Section 9-6.1 and 9-6.2.

Note that an engineered protection system is required to achieve a reduced clearance installation except when appliances are installed in rooms that are large in comparison to the size of the appliance - see NFPA 211, Section 9-6.1.

3610.6.9 Supply ducts: When a solid fuel-burning appliance utilizes supply ducts such ducts conveying heated air shall be fabricated of noncombustible materials.

Exception: Combustible ducts specifically tested and listed for such purpose.

3610.6.9.1 Supply duct clearance to combustibles: Supply ducts conveying heated air shall have a clearance to combustibles of not less than 12 inches for the first ten feet of distance from the appliance plenum/bonnet.

Exception: ducts specifically tested and listed for such purpose.

3610.6.10 Multiple flue connections: A solid fuel-burning appliance and a fossil fuel-burning appliance shall not be vented into a common flue of a masonry chimney unless such common connection is allowed by 248 CMR or 527 CMR as applicable. If allowed, the common flue shall be of such size to serve all appliances connected if such appliances were operated simultaneously.

Note that 248 CMR and 527 CMR are enforced by Gas Inspectors and the Heads of Fire Departments, respectively.

3610.6.10.1 Multiple flue connections not allowed: A solid fuel-burning appliance shall not share a common flue with a working fireplace nor with another solid fuel-burning appliance (also see 780 CMR 3610.6.10 above).

Exception: 780 CMR 3610.6.6.

3610.6.11 Used solid fuel-burning appliances - installation inspection: Used solid fuel-burning appliances that predate the listing requirements set forth in 780 CMR 3610 may be utilized but the installation of such appliances shall otherwise conform to the requirements of 780 CMR 3610 and such installations shall be inspected by the Building Official (or Fire Official in such towns that utilize the Fire Official for such inspection purposes).

3610.6.11.1 Used solid fuel-burning appliance clearances to combustibles: In the absence of tested, listed clearances and floor protection requirements, used solid fuel-burning appliances shall be required to be installed in accordance with the clearances of Table 3610.6.11. Floor protection requirements shall be evaluated by engineering methods or otherwise four inches of ⅜ inch millboard having a thermal conductivity of :

$k = 0.84$ (Btu) (inch) / (foot^2) (hour) (°F)

or an equivalent noncombustible *floor protector* of the same overall thermal conductivity shall be required (also see 780 CMR 3610.6.7.1.1).

Exception 1: If tested, listed clearances and/or floor protection requirements are documentable for the specific used appliance being installed, then such clearances and/or floor protection may be utilized.

Exception 2: If known tested, listed clearances are greater than those of Table 3610.6.11, then such clearances must be maintained.

Exception 3: If existing floor protection can be demonstrated to have been adequate for previous installations of said used solid fuel-burning appliances then such previously utilized floor protection shall be allowed. If calculations demonstrate that the existing floor protection has a thermal conductivity lower than that set by 780 CMR 3610.6.11.1 and adequacy has otherwise been demonstrated, then the existing floor protection must be maintained.

Table 3610.6.11[1,2,3]

STANDARD CLEARANCES TO COMBUSTIBLES FOR SOLID FUEL-BURNING APPLIANCES

Appliance Type	Clearance Above Top of Appliance (inches)	Clearance from Front of Appliance (inches)	Clearance from Back of Appliance (inches)	Clearance from Sides of Appliance (inches)
Room Heaters; Fireplace Stoves; Combination	36	36	36	36

1. For reduced clearance requirements, see 780 CMR 3610. 6.8.1
2. Adequate clearance for maintenance and cleaning shall be provided.
3. Provisions for solid fuel storage - solid fuel shall not be stored any closer than 36 inches from the sides, front or back of the solid fuel-burning appliance.

MECHANICAL ADMINISTRATION

(This Section is Entirely Unique to Massachusetts)

3611.1 GENERAL

3611.1.1 Scope. The provisions of 780 CMR 3611 shall establish the general scope of the mechanical system and equipment requirements of 780 CMR.

3611.1.2 Definitions: General definitions are provided in 780 CMR 3612.1

3611.1.3 Application: In addition to the general administration requirements of 780 CMR 1, the provisions of 780 CMR 3611 - 780 CMR 3622 shall apply; additionally, in the absence of specific criteria set forth in such sections, the International Mechanical Code, as listed in ***Appendix A*** shall apply.

> **Note**: This supplementing of the administrative provisions is necessary, in part, as the regulatory requirements of other State Agencies legally impact the design, installation and maintenance of fossil fuel-fired appliances; i.e., 527 CMR for oil-fired appliances and 248 CMR for gas-fired appliances and specifically 527 CMR 12 as the Massachusetts Electrical Code.

3611.1.4 Conformity: Conformity with the applicable Code of Massachusetts Regulations (527 CMR and 248 CMR) or otherwise with the applicable provisions of 780 CMR 3611 - 780 CMR 3622 is required.

780 CMR 3611.2 - EXISTING MECHANICAL SYSTEMS

3611.2.1 Additions, alterations, repairs or replacement: Additions, alterations, repairs or replacement shall be made to existing mechanical systems in accordance with the requirements of the applicable CMR (527 CMR or 248 CMR) except that in the absence of other CMR regulatory control, in an existing one- or two-family detached home, any new mechanical system shall conform to 780 CMR for new construction to the fullest extent practical. However, individual components of an existing mechanical system may be repaired or replaced without requiring that system to comply with 780 CMR for new construction, provided such component repair or replacement shall not cause an existing system to become unsafe, unsanitary or overloaded.

NON-TEXT PAGE

MECHANICAL DEFINITIONS

3612.1 GENERAL

3612.1.1 Scope: Unless otherwise expressly stated, the following terms shall, for the purpose of *780 CMR*, have the meanings indicated in 780 CMR 3612.1. Words used in the present tense include the future; the singular number includes the plural and the plural the singular. ***Where terms are not defined in 780 CMR 3612.1 and are defined in 780 CMR 2 they shall have the meanings ascribed to them in 780 CMR 2. Where terms are not defined in 780 CMR 2 or 780 CMR 3612.1, they shall have their ordinarily accepted meanings.***

> ***Note: Such definitional terms are provided to establish a uniform technical language consistent with definitional terms of 527 CMR, 248 CMR, NFPA-31, NFPA-54 and the International Mechanical Code, as applicable.***

780 CMR 3612.2.1 - GENERAL MECHANICAL DEFINITIONS

ACCESSIBLE: Signifies access that requires the removal of an access panel or similar removable obstruction.

ACCESSIBLE, READILY: Signifies access without the necessity for removing a panel or similar obstruction.

AIR CIRCULATION, FORCED: A means of providing space conditioning utilizing movement of air through ducts or plenums by mechanical means.

AIR-CONDITIONING SYSTEM: An air-conditioning system consists of heat exchangers, blowers, filters, supply, exhaust and return-air systems and shall include any apparatus installed in connection therewith

ALTERATION: A change in an air-conditioning, heating, ventilating or refrigeration system that involves an extension, addition or change to the arrangement, type or purpose of the original installation.

APPLIANCE: A device which utilizes fuel or other forms of energy to produce light, heat, power, refrigeration or air-conditioning. This definition shall also include a vented decorative gas appliance and decorative gas appliances for installation in vented solid-fuel-burning fireplaces. Unlisted gas-fired log lighters shall not be considered appliances.

BOILER, HOT WATER HEATING: A self-contained appliance from which hot water is circulated for heating purposes and then returned to the boiler, and which operates at water pressures not exceeding 160 pounds per square inch gage (psig) (1102 kPa gage) and at water temperatures not exceeding 250°F (121°C) near the boiler outlet.

BRAZED JOINTS: A joint obtained by the joining of metal parts with metals or alloys that melt at a temperature above 1,000°F (538°C) but lower than the melting temperature of the parts to be joined.

Btu/h: The listed maximum capacity of any appliance, absorption unit or burner expressed in British thermal units input per hour.

CHIMNEY: (See also "Vent") One or more passageways, vertical or nearly so, for conveying flue gases to the outside atmosphere.

CHIMNEY CONNECTOR: A pipe that connects a fuel-burning appliance to a chimney.

CLOSET: A small room or chamber used for storage.

COMBUSTIBLE MATERIAL: Any material not defined as noncombustible.

COMBUSTION AIR: The air provided to fuel-burning equipment including air for fuel combustion, draft hood dilution and ventilation of the equipment enclosure.

CONCEALED GAS PIPING: Piping that is enclosed in the building construction without means of access.

CONDENSATE: The liquid which separates from a gas due to a reduction in temperature, e.g., water that condenses from flue gases and water that condenses from air circulating through the cooling coil in air-conditioning equipment.

CONDENSING APPLIANCE: An appliance that condenses water generated by the burning of fuels.

CONDITIONED AIR: Air treated to control its temperature, relative humidity or quality.

CONDITIONED SPACE: The space contained within a building which is conditioned directly or indirectly by heating the operation of a cooling appliance.

CONFINED SPACE: A room or space having a volume less than 50 cubic feet per 1,000 Btu/h (4X3 L/W) of the aggregate input rating of all fuel-burning appliances installed in that space.

CONTROL, LIMIT: An automatic control responsive to changes in liquid flow or level, pressure, or temperature for limiting the operation of an appliance.

CONTROL, PRIMARY SAFETY: A safety control responsive directly to flame properties that senses the presence or absence of flame and, in event of ignition failure or unintentional flame extinguishment, automatically causes shutdown of mechanical equipment.

CONVECTOR: A system incorporating heating element in an enclosure in which air enters an opening below the heating element, is heated and leaves the enclosure through an opening located above the heating element.

CONVENIENCE OUTLET,GAS: A permanently mounted hand-operated device for connecting and disconnecting an appliance to the gas supply piping conforming to AGA Requirement 7-90. The device includes an integral, manually operated gas valve so that the appliances can be disconnected only when the valve is in the closed position.

DAMPER, VOLUME: A device that will restrict, retard or direct the flow of air in any duct, or the products of combustion of heat-producing equipment, vent connector, vent or chimney.

DECORATIVE GAS APPLIANCE, VENTED: A vented appliance installed for the aesthetic effect of the flames rather than functional effects.

DECORATIVE GAS APPLIANCES FOR INSTALLATION IN VENTED SOLID-FUEL-BURNING FIREPLACES: A self-contained, freestanding, fuel-gas-burning appliance designed for installation only in a vented solid-fuel-burning fireplace and whose primary function lies in the aesthetic effect of the flame.

DILUTION AIR: Air that enters a draft hood or draft regulator and mixes with flue gases.

DIRECT-VENT APPLIANCE: A fuel-burning appliance with a sealed combustion system that draws all air for combustion from the outside atmosphere and discharges all flue gases to the outside atmosphere.

DRAFT: The flow of gases or air through chimney, flue or equipment caused by pressure differences.
Mechanical or induced: The draft developed by fan, air, steam jet or other mechanical means.
Natural: The draft developed by the difference in temperature of hot gases and outside atmosphere.

DRAFT HOOD: A device built into an appliance, or a part of the vent connector from an appliance, which is designed to (1) provide for the ready escape of the flue gases from the appliance in the event of no draft, backdraft or stoppage beyond the draft hood, (2) prevent a backdraft from entering the appliance, and (3) neutralize the effect of stack action of the chimney or gas vent on the operation of the appliance.

DRAFT REGULATOR: A device which functions to maintain a desired draft in the appliance by automatically reducing the draft to the desired value.

DUCT SYSTEM: A duct system is a continuous passageway for the transmission of air which, in addition to ducts, may include duct fittings, dampers, plenums, fans and accessory airhandling equipment.

EQUIPMENT: A general term including materials, fittings, devices, appliances and apparatus used as part of or in connection with installations regulated by 780 CMR 36.

EVAPORATIVE COOLER: A device used for reducing air temperature by the process of evaporating water into an airstream.

EXCESS AIR: Air which passes through the combustion chamber and the appliance flue in excess of that which is theoretically required for complete combustion.

EXHAUST HOOD, FULL OPENING: An exhaust hood with an opening at least equal to the diameter of the connecting vent.

FACTORY-BUILT CHIMNEY: A chimney composed of listed and labeled factory-built components assembled in accordance with the manufacturer's installation instructions to form the completed chimney.

FIREPLACE: A listed and labeled factory-built or site-built hearth and fire chamber constructed of noncombustible material for use with solid fuels and provided with a chimney.

FIREPLACE STOVE: A freestanding, chimney-connected solid-fuel-burning heater with or without doors connected to the chimney.

FLAME-SPREAD INDEX: A numerical index indicating the relative surface-burning behavior of a material tested in accordance with ASTM E 84.

FLOOR FURNACE: A self-contained furnace suspended from the floor of the space being heated, taking air for combustion from outside such space, and with means for lighting the appliance from such space.

FLUE: See "Vent."

FLUE, APPLIANCE: The passages within an appliance through which combustion products pass from the combustion chamber to the flue collar.

FLUE COLLAR: The portion of a fuel-burning appliance designed for the attachment of a draft hood, vent connector or venting system.

FLUE GASES: Products of combustion plus excess air in appliance flues or heat exchangers.

FUEL-PIPING SYSTEM: All piping, tubing, valves and. fittings used to connect fuel utilization equipment to the point of fuel delivery.

FURNACE, WARM-AIR: A vented heating appliance designed or arranged to discharge heated air into a conditioned space.

GAS: Fuel gas, such as natural gas, manufactured gas, undiluted liquefied petroleum gas (vapor phase only), liquefied petroleum gas-air mixture or mixtures of these gases.

GAS PRESSURE REGULATOR: See "Regulator."

HEAT PUMP: An appliance having heating or heating/cooling capability and which uses refrigerants to extract heat from air, liquid or other sources.

HIGH-TEMPERATURE (H.T.) CHIMNEY: A high temperature chimney complying with the requirements of UL 103. A Type H.T. chimney is identifiable by the markings "Type H.T." on each chimney pipe section.

LABELED: Devices, equipment or materials to which have been affixed a label, seal, symbol or other identifying mark of a testing laboratory, inspection agency or other organization concerned with product evaluation that maintains periodic inspection of the production of the above labeled items which attests to compliance with a specific standard.

LISTED and LISTING: Terms referring to equipment which is shown in a list published by an approved testing agency qualified and equipped for experimental testing and maintaining an adequate periodic inspection of current productions and whose listing states that the equipment complies with nationally recognized standards when installed in accordance with the manufacturer's installation instructions.

LOG LIGHTER, GAS-FIRED: An unlisted manually operated gas-fired solid-fuel ignition device for installation in a vented solid-fuel-burning fireplace.

LOW-PRESSURE GAS SUPPLY SYSTEM: A gas supply system with gas pressure at or below 0.5 psig (3.44 kPa gage).

LP GAS: Liquefied petroleum gas composed predominately of propane, propylene, butanes or butylenes, or mixtures thereof which are gaseous under normal atmospheric conditions, but can be liquefied under moderate pressure at normal temperatures.

MANUFACTURER'S INSTALLATION INSTRUCTIONS: Printed instructions included with equipment as part of the conditions of listing and labeling.

MASONRY CHIMNEY: A field-constructed chimney of masonry units, bricks, stones, labeled masonry chimney units, or reinforced portland cement concrete, lined with suitable chimney flue liners.

MECHANICAL EXHAUST SYSTEM: Equipment installed in a venting system to provide an induced draft.

MEDIUM-PRESSURE GAS SUPPLY SYSTEMS: A gas supply system with gas pressure exceeding 0.5 psig (3.44 kPa gage) but not exceeding 5 psig (34 kPa gage).

NONCOMBUSTIBLE MATERIAL: Materials that pass the test procedure for defining noncombustibility of elementary materials set forth in ASTM E 136.

NONCONDITIONED SPACE: A space that is isolated from conditioned space by insulated walls, floors or ceilings.

PLENUM: A chamber which forms part of an air-circulation system other than the occupied space being conditioned.

PURGE: To clear of air, gas or other foreign substances.

QUICK-DISCONNECT DEVICE: A hand-operated device that provides a means for connecting and disconnecting an applianceto a gas supply and that is equipped with an automatic means to shut off the gas supply when the device is disconnected.

REFRIGERANT: A substance used to produce refrigeration by its expansion or evaporation.

REFRIGERANT COMPRESSOR: A specific machine, with or without accessories, for compressing a given refrigerant vapor.

REFRIGERATING SYSTEM: A combination of interconnected refrigerant-containing parts constituting one closed refrigerant circuit in which a refrigerant is circulated for the purpose of extracting heat. In a direct cooling system, the refrigeration is circulated through a heat exchanger located in an air passage. In an indirect cooling system. a secondary working fluid is cooled by the refrigerating system and circulated through a heat exchanger located in an air passage.

REGULATOR: A device for reducing, controlling and maintaining the pressure in a portion of a piping system downstream of the device.

REGULATOR VENT: The opening in the atmospheric side of the regulator housing permitting the movement of air to compensate for the movement of the regulator diaphragm.

RETURN AIR: Air removed from a conditioned space through openings, ducts, plenums or concealed spaces to the heat exchanger of a heating, cooling or ventilating system.

ROOM HEATER: A freestanding heating appliance installed in the space being heated and not connected to ducts.

SERVICE PIPING: The piping and equipment between the street gas main and the gas-piping system inlet, which is installed by and is under the control and maintenance of the serving gas supplier.

SMOKE-DEVELOPED RATING: A numerical index indicating the relative density of smoke produced by burning assigned to a material tested in accordance with ASTM E 84.

SUPPLY AIR: Air delivered to a conditioned space through ducts or plenums from the heat exchanger of a heating, cooling or ventilating system.

TYPE B VENT: A listed and labeled vent conforming to UL 441 for venting gas appliances with draft hoods and other gas appliances listed for use with Type B vents.

TYPE BW VENT: A listed and labeled vent conforming to UL 1 441 for venting gas-fired vented wall furnaces listed for use with Type BW vents.

TYPE L VENT: A listed and labeled vent conforming to UL 641 for venting oil-burning appliances listed for use with Type L vents or with listed gas appliances.

UNUSUALLY TIGHT CONSTRUCTION: Construction in which:

1. Walls and ceilings exposed to the outside atmosphere have a continuous water vapor retarder with a rating of one perm [57.4 ng/(s-m2 Pa)] or less with openings gasketed or sealed, and
2. Weatherstripping has been added on openable windows and doors, and
3. Caulking or sealants are applied to areas such as joints around window and door frames between sole plates and floors, between wall-ceiling joints, between wall panels, at penetrations for plumbing, electrical and gas lines, and at other openings.

VENT: A passageway for conveying flue gases from fuel-fired appliances, or their vent connectors, to the outside atmosphere.

VENT COLLAR: see "flue collar."

VENT CONNECTOR: That portion of a venting system which connects the flue collar or draft hood of an appliance to a vent.

VENT DAMPER DEVICE, AUTOMATIC: A device intended for installation in the venting system, in the outlet of or downstream of the appliance draft hood, of an individual, automatically operated fuel-burning appliance and which is designed to automatically open the venting system when the appliance is in operation and to automatically close off the venting system when the appliance is in a standby or shutdown condition.

VENT GASES: Products of combustion from fuel-burning appliances, plus excess air and dilution air, in the venting system above the draft hood or draft regulator.

VENTED GAS APPLIANCE CATEGORIES: The following categories are used to differentiate gas utilization equipment according to vent pressure and flue gas temperature.

Category I. An appliance that operates with a nonpositive vent connector pressure and with a flue gas temperature at least 140°F (60°C) above its dewpoint.

Category II. An appliance that operates with a nonpositive vent connector pressure and with a flue gas temperature less than 140°F (60°C) above its dewpoint.

Category III. An appliance that operates with a positive vent pressure and with a flue gas temperature at least 140°F (60°C) above its dewpoint.

Category IV. An appliance that operates with a positive vent pressure and with a flue gas temperature less than 140°F (60°C) above its dewpoint.

VENTILATION: The process of supplying or removing conditioned or unconditioned air by natural or mechanical means to or from any space.

VENTING: Removal of combustion products to the outdoors.

WATER HEATER: A closed vessel in which water is heated by the combustion of fuels, electricity or other energy source and withdrawn for use external to the vessel at pressures not exceeding 160 psig (1102 kPa gage), including the apparatus by which heat is generated and all controls and devices necessary to prevent water temperatures from exceeding 210°F (99°C).

NON-TEXT PAGE

780 CMR 3613

GENERAL MECHANICAL SYSTEM REQUIREMENTS

(*This Section is Entirely Unique to Massachusetts*)

3613.1 GENERAL

3613.1.1 Scope: The provisions of 780 CMR 3613.0 shall govern the installation of mechanical systems not specifically addressed elsewhere in 780 CMR 36.

780 CMR 3613.2 APPROVAL

3613.2.1 Heating and cooling appliances: Fossil-fueled heating and cooling appliances shall be listed and bear the label of an approved agency in accordance with the requirements of 527 CMR or 248 CMR as applicable; other heating and cooling appliances not under the jurisdictional control of 527 CMR or 248 CMR shall be provided with listing labeling information as set forth in 780 CMR 3613.3.1, 3613.3.2, or 3613.3.3 as applicable or otherwise be approved by the BBRS when such approval is necessary.

> **Note**: for solid fuel-burning appliances, see 780 CMR 3610.

780 CMR 3613.3 LABELING OF EQUIPMENT NOT UNDER THE CONTROL OF 527 CMR OR 248 CMR

3613.3.1 General: All appliances shall bear a permanent and legible factory-applied label which shall include the following information:

1. Name or trademark of the manufacturer.
2. The model and serial number.
3. Identity of the agency certifying compliance of equipment with approved standards.
4. Clearances from combustible construction for heat-producing appliances.

3613.3.2 Fuel-burning appliances: The listing and label for fuel-burning appliances, except wood stoves and fireplaces (for solid fuel-burning appliances and fireplaces see 780 CMR 3610.1), shall also indicate:

1. The type of fuel approved for use with the appliance.
2. The input or output ratings.
3. Instructions for the lighting operation and shut off of the appliance.

3613.3.3 Other than fuel-burning appliances: When the design, installation and maintanence of other than fuel-burning appliances falls under the jurisdiction of 780 CMR, the listing and label for such appliances shall also indicate:

1. The output rating in Btu/h or kw.
2. The electrical rating in volts, amperes (or watts) and, for other than single phase, the number of phases.
3. The electrical rating in volts, amperes or watts of each field-replaceable electrical component.
4. Amount and type of refrigerant, and factory test pressures or pressures applied for heat pumps and refrigeration cooling equipment.

780 CMR 3613.4 TYPE OF FUEL

3613.4.1 Appliances: Each appliance shall be designed for use with the type of fuel to which it is to be connected. Appliances shall not be converted from fuel specified on the rating plate for use with a different fuel without conforming to the applicable requirements of 527 CMR or 248 CMR for oil or gaseous fuels respectivley or otherwise securing approval from the BBRS for other types of appliances.

780 CMR 3613.5 APPLIANCE ACCESS

1305.1 Appliance access for inspection service, repair and replacement: Fossil fueled appliances shall conform to the access requirements set fort in 527 CMR or 248 CMR as applicable; additionally, all appliances shall be accessible for inspection, service, repair and replacement without removing permanent construction. In the absence of manufacturer's listing/installation requirements, thirty inches (762 mm) of working space and platform shall be provided in front of the control side to service an appliance not otherwise under the jurisdictional control of 527 CMR or 248 CMR .

> **Note**: solid-fuel burning appliances shall comply with the applicable requirements of 780 CMR 3610.

780 CMR 3613.6 CLEARANCES FROM COMBUSTIBLE CONSTRUCTION

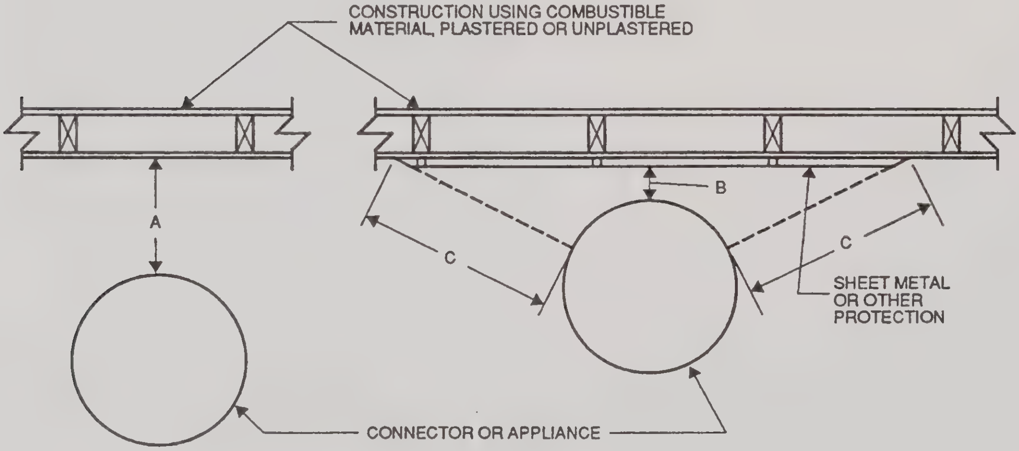
3613.6.1 Appliance clearance: Appliances shall comply with the clearance requirements of 527 CMR or 248 CMR as applicable or: if not under the jurisdictional control of 527 CMR or 248 CMR shall have clearances from combustible materials in accordance the manufacturer's listing requirements or in the absence of such information, in accordance with Figure 3613.6.1 and Tables 3613.6.1a and 3613.6.1b as applicable. Forms of protection with ventilated air space shall conform to the following requirements:

1. Not less than one-inch (25 mm) air space shall be provided between the protection and combustible wall surface.
2. Air circulation shall be provided by having edges of the wall protection open at least one inch (25 mm).
3. If the wall protection is mounted on a single flat wall away from corners, air circulation shall be provided by having the bottom and top edges, or the side and top edges open at least one inch (25 mm).
4. Wall protection covering two walls in a corner shall be open at the bottom and top edges at least one inch (25 mm).

780 CMR 3613.7 APPLIANCE INSTALLATION

3613.7.1 General: Fossil fuel-fired appliances shall be installed in accordance with the applicable requirements of 527 CMR or 248 CMR. The installation of appliances not under the jurisdictional control of 527 CMR or 248 CMR shall conform to the conditions of the manufacturer's listing/ installaion requirements. The manufacturer's operating instructions shall remain attached to the appliance or otherwise be provided to the installer and end-user of such appliances.

FIGURE 3613.6.1 - REDUCED CLEARANCE DIAGRAM


CONSTRUCTION USING COMBUSTIBLE MATERIAL, PLASTERED OR UNPLASTERED
A
B
C
C
SHEET METAL OR OTHER PROTECTION
CONNECTOR OR APPLIANCE

Note:
"A" equals the required clearance with no protection, specified in Table 3613.6.1a. "B" equals the reduced clearance permitted with Table 3613.6.1b. The protection applied to the construction using combustible material shall extend far enough in each direction to make "C" equal to "A".

TABLE 3613.6.1a
STANDARD INSTALLATION CLEARANCES FOR HEATING APPLIANCE[1]

RESEDENTIAL-TYPE APPLIANCES	CLEARANCE (inches)			
	Above Top[2]	From Front	From Back	From Sides
Boilers and Water Heaters:				
Automatic oil or combination gas and oil-	6	24	6	6
Automatic gas-	6	18	6	6
Solid-	6	48	6	6
Electric-	6	18	6	6
Central Furnaces:				
Automatic oil or combination gas and oil-	6	24	6	6
Automatic gas-	6	18	6	6
Solid-	18	48	18	18
Electric-	6	18	6	6
Floor Furnaces:				
Automatic oil or combination gas and oil-	36	12	12	12
Automatic gas-	36	12	12	12
Room Heaters:[3]				
Circulating type:				
Oil or solid fuel-	36	24	12	12
Gas-	36	24	12	12
Radiant or other type:				
Oil or solid fuel-	36	36	36	36
Gas-	36	36	18	18
Gas with double metal or ceramic back-	36	36	12	18
Fireplace stove:				
Solid fuel-	48	54	48	48

For SI: 1 inch = 25.4 mm.

1. Reductions in the required clearance shall be permitted in accordance with Table 3613.6.1b.
2. Same clearances required from top and sides of warm air bonnet or plenum of central furnaces.
3. Room heaters shall be installed on noncombustible floors.

TABLE 1306.1b
REDUCED CLEARANCES WITH SPECIFIED FORMS OF PROTECTION (inches)

TYPE OF PROTECTION	WHERE REQUIRED CLEARANCE WITH NO PROTECTION IS							
	36		19		12		6	
	CLEARANCE MAY BE REDUCED TO							
	Wall	Ceiling	Wall	Ceiling	Wall	Ceiling	Wall	Ceiling
½-inch noncombustible insulation board over one-inch glass fiber or mineral wood butts with no air space	18	24	9	12	6	8	3	4
½-inch-thick noncomnustible insulation board with ventilated air space	12	18	6	9	4	6	2	3
24-gage sheet metal with ventilated air space	12	18	6	9	4	6	2	3
3½-inch thick masonry wall with air space	12	-	6	-	4	-	2	-

For SI: = 1 inch = 25.4 mm, 1 pound per cubic foot = 0.1572 kN/m^3, °F = 1.8°C + 32, 1 (Btu-inch)/(square foot hour-°F) = 1.721 W/(m-K).

Notes:

1. Required clearances shall be measured as shown in Figure 3613.6.1.
2. The clearance between the appliance and the face of the protection shall not be reduced below that shown in the table. Required clearances between those shown in the table may be interpolated.
3. With all clearance reduction systems using ventilated are space, air circulation shall be provided as described in 780 CMR 3613.6.1.
4. Spacers and ties shall be noncombustible and shall not be used directly behind an appliance or a connector.
5. Mineral wood butts shall have a minimum density of eight pounds per cubic foot and a minimum melting point of 1,500°F.
6. Insulation material shall have a thermal conductivity of 1.0 (Btu-in.)/(sq. ft.-hr°F) or less.
7. A single wall connector passing through the masonry wall shall have at least ½ inch of open ventilated air space between the connector and the masonry.

3613.7.1.1 Additional installation requirements/appliances located in garages: The requirements of 527 CMR or 248 CMR shall be met when fossil fueled heating and/or cooling appliances are to be located in a garage; additionally, all appliances shall be protected from impact by automobiles. Appliances that generate a glow, spark or flame capable of igniting gasoline vapors and located in a garage shall be installed with burners, burner ignition devices, or heating elements and switches at least 18 inches (457 mm) above the floor level or as further required by 527 CMR or 248 CMR when applicable. When such appliances are enclosed in a separate compartment having access only from outside of the garage, such appliances may be installed at floor level, provided that the required combustion air is taken from and discharged to the exterior of the garage.

3613.7.2 Electrical appliances: Electrical appliances shall be installed in accordance with 527 CMR 12.

780 CMR 3613.8 CONTROL DEVICES

3618.8.1 Oil-fired and gas-fired appliances: See 527 CMR or 248 CMR as applicable.

3613.8.2 Electric duct heaters: Electric duct heaters shall be equipped with an automatic reset air outlet temperature-limit control that will limit the outlet air temperature to no more than 200°F (93°C). The electric elements of the heater shall be equipped with fusible links or a manual reset temperature-limit control that will prevent air temperature in the immediate vicinity of the heating elements from exceeding 25°F (121°C).

HEATING AND COOLING EQUIPMENT

(This Section is Entirely Unique to Massachusetts)

3614.1 GENERAL

3614.1.1 General: All heating and cooling appliances that are fossil-fuel fired shall conform to the requirements of 780 CMR 3614.0.

> **Note 1**: Solid fuel burning appliances shall conform to the requirements of 780 CMR 3610.
>
> **Note 2**: Boilers and water heaters shall additionally comply with the requirements of 248 CMR and 527 CMR, as applicable.

3614.1.2 Installation: Heating and cooling equipment installation shall be in accordance with the specific requirements of 527 CMR for oil fired equipment and 248 CMR for gas-fired equipment or otherwise in accordance with the general requirements of 780 CMR 36 when such equipment is not under the jurisdictional control of 527 CMR or 248 CMR.

> **Note 1**: When explicit requirements of 527 CMR and/or 248 CMR apply, enforcement of such explicit requirements lies with the Head of the Fire Department of the jurisdiction (or his designee) for matters controlled under 527 CMR and with the Gas Inspector of the jurisdiction for matters controlled under 248 CMR.
>
> **Note 2**: 248 CMR explicitly regulates the size, type, listing and installation criteria for gas-fired appliances, associated connector, equipment venting, including chimney flue size and liner criteria and combustion air and appliance venting criteria.
>
> **Note 3**: 527 CMR explicitly regulates the size, type, listing and installation criteria for oil-fired appliances, associated connector piping, combustion air and appliance ventilation criteria and certain aspects of equipment venting criteria but otherwise defaults to 780 CMR for chimney flue size and liner criteria.
>
> **Note 4**: Where flue liner size and/or material is otherwise not controlled by 527 CMR or 248 CMR, flue size and material type shall conform to the requirements of 780 CMR and the appliance manufacturer's listing/installation requirements.

3614.1.3 Ventilation requirements: See 780 CMR 3617.1

3614.1.4 Exhaust system requirements: See 780 CMR 3618.1.

3614.1.5 Duct construction requirements: See 780 CMR 3619.1.

3614.1.6 Combustion air requirements: See 780 CMR 3620.1.

3614.1.7 Chimney and vent requirements: See 780 CMR 3621.1 and 780 CMR 3610, generally.

3614.1.8 Access: Heating and cooling equipment shall be located relative to building construction and other equipment in such manner as to permit maintenance, servicing and replacement. Refer to the specific requirements of 527 CMR or 248 CMR as applicable; otherwise such equipment access shall comply to applicable requirements of 780 CMR 36 and the manufacturer's specific listing/installation requirements.

3614.1.9 Sizing: Comfort heating and cooling equipment shall be sized according 780 CMR 3603.21.

3614.1.10 Heating and cooling equipment room installations: Refer to the specific requirements of 527 CMR or 248 CMR as applicable or otherwise such installations shall comply to applicable requirements of 780 CMR 36 and the manufacturer's specific listing/installation requirements.

> **3614.1.10.1 Additional installation requirements/attic installations**: Refer to the specific requirements of 527 CMR or 248 CMR as applicable; otherwise such installations shall comply to applicable requirements of 780 CMR 36 and the manufacturer's specific listing/installation requirements.
>
> > **Note** that attic installation of heating equipment and associated duct/piping requires care that heating system heat loss to the attic space does not lead to roof winter ice damming. Materials acceptable to the building official shall be presented to demonstrate that heating system heat loss to the attic space will not result in heat loss to the space sufficient to promote roof ice damming. To reduce heat loss to the attic space, if the attic heating system is insulated or placed in an isolated, insulated space, such approach shall in no way violate manufacturer's listing requirements of the heating equipment nor preclude proper combustion air, ventilation or exhaust of such equipment and/or space.

3614.1.10.1.1 Electricity required: For attic installations, a permanent electric outlet and lighting fixture shall be provided near the equipment which shall be controlled by a switch and installed in accordance with 527 CMR 12.00.

3614.1.10.2 Additional installation requirements/crawl space installations: Refer to 527 CMR or 248 CMR as applicable or in the absence of such jurisdictional guidance, equipment supported from the ground shall be level and firmly supported on frost-protected construction extending not less than three inches (76 mm) above the adjoining ground. Equipment suspended from the floor shall have a clearance of not less than six inches (153 mm) from the ground.

3614.1.10.2.1 Electricity required: A permanent electric outlet and lighting fixture shall be provided near the equipment controlled by a switch and installed in accordance with 527 CMR 12.

3614.1.10.3 Additional installation requirements/exterior installations: Refer to the specific requirements of 527 CMR or 248 CMR as applicable, or in the absence of such jurisdictional guidance such supports and foundations shall prevent excessive vibration, settlement, or movement of the equipment. Supports and foundations shall be level and conform to the manufacturer's installation instructions and be frost-protected.

780 CMR 3614.1.11 - Fossil fired furnaces and boilers:

3614.1.11.1 General: All fossil-fired furnaces and boilers shall conform to the requirements of 527 CMR or 248 CMR as applicable. Such furnaces and boilers shall not be installed in a room designed to be used as a storage closet unless allowed by both the manufacturer and by either 527 CMR or 248 CMR as applicable. Furnaces and boilers located in a bedroom or bathroom shall be installed in a sealed enclosure such that combustion air will not be taken from the living space unless such furnaces or boilers are of a direct vent type.

Exception: Unless required by 527 CMR or 248 CMR, direct vent furnaces are not required to be installed within an enclosure.

3614.1.11.1.1 Clearances: Refer to the specific requirements of 527 CMR or 248 CMR as applicable, or otherwise clearances to combustibles shall comply with applicable requirements of 780 CMR 36 and the manufacturer's specific listing/installation requirements.

3614.1.12 Electric furnaces: Electric furnaces shall be constructed in accordance with UL 1096. Electric furnaces shall be installed in compliance with 780 CMR 36, their listing, the manufacturer's installation instructions and 527 CMR 12.00.

780 CMR 3614.2 HEAT PUMP EQUIPMENT

3614.2.1 Heating elements: Heat pump equipment utilizing supplemental electric heating elements shall have such elements constructed in accordance with UL 559 and installed in accordance with 527 CMR 12.00.

3614.2.1 Foundations and supports: Supports and foundations for the outdoor unit of a heat pump shall be raised at least three inches (76 mm) above the ground to permit free drainage of defrost water, shall conform to the manufacturer's installation instructions and be frost-protected.

780 CMR 3614.3 REFRIGERATION COOLING EQUIPMENT

3614.3.1 Compliance: When applicable, refrigeration cooling equipment and its installation shall comply with M.G.L. c. 146, §§ 42 through 45A, 81 and 528 CMR 11.

780 CMR 3615

ELECTRIC RESISTANCE HEATING

780 CMR 3615.1 GENERAL

3615.1.1 General: Electric baseboard convectors shall be listed and labeled and shall be installed in accordance with the manufacturer's installation instructions and 527 CMR 12.00.

780 CMR 3615.2 RADIANT HEATING SYSTEMS

3615.2.1 General: Radiant heating systems shall be listed and labeled and shall be installed in accordance with the manufacturer's installation instructions and 527 CMR 12.00.

3615.2.2 Clearances: Clearances for radiant heating panels or elements to any wiring, outlet boxes, and junction boxes used for installing electrical devices or mounting lighting fixtures shall comply with manufacturer's listing requirements and 527 CMR 12.00.

3615.2.3 Installation of radiant panels on wood framing: Radiant panels installed on wood framing shall only be so installed if so listed by the manufacturer and additionally shall conform to the following requirements:

1. Heating panels shall be installed parallel to framing members and secured to the surface of framing members or mounted between framing members.
2. Panels shall be nailed or stapled only though the unheated portions provided for this purpose and shall not be fastened at any point closer than ¼ inch (6.4 mm) from an element.
3. Unless listed and labeled for field cutting, heating panels shall be installed as complete units.

3615.2.4 Installation of radiant panels in concrete or masonry: Radiant heating systems installed in concrete or masonry shall only installed if so listed by the manufacturer and additionally conform to the following requirements:

1. Radiant heating systems shall be identified as being suitable for the installation and shall be secured in place as specified in the manufacturer's installation instructions.
2. Radiant heating panels or radiant heating panel sets shall not be installed where they bridge expansion joints unless protected from expansion and contraction.

3615.2.5 Installation of radiant panels in gypsum assemblies: Radiant heating systems shall only be used in gypsum assemblies when so listed by the manufacturer and such panel operating temperatures shall not exceed 125°F (52°C).

3615.2.6 Finish surfaces: Finish materials installed over radiant heating panels or systems shall be installed in accordance with the manufacturer's installation instructions. Surfaces shall be secured so that nails or other fastenings do not pierce the radiant heating elements.

780 CMR 3615.3 DUCT HEATERS

3615.3.1 General: Electric duct heaters shall be listed and labeled and shall be installed in accordance with the manufacturer's installation instructions and 527 CMR 12.

3615.3.2 Installation: Electric duct heaters shall be installed so that they will not create a fire hazard. Class I ducts, duct coverings and linings shall be interrupted at each heater to provide the clearances specified in the manufacturer's installation instructions. Such interruptions are not required for duct heaters listed and labeled for zero clearance from combustible materials. Insulation installed in the immediate area of each heater shall be classified for the maximum temperature produced on the duct surface.

3615.3.3 Installation with heat pumps and air conditioners: Duct heaters located within four feet (1219 mm) of a heat pump or air conditioner shall be listed and labeled for such installations. The heat pump or air conditioner shall additionally be listed and labeled for such duct heater installations.

3615.3.4 Access: Duct heaters shall be accessible for servicing, and clearance shall be maintained to permit adjustment, servicing, and replacement of controls and heating elements in accordance with the manufacturer's listing/installation requirements and otherwise in accordance with any applicable requirements of 780 CMR 36.

NON-TEXT PAGE

780 CMR 3616

VENTED FLOOR, WALL AND ROOM HEATERS

780 CMR 3616.1 GENERAL

3616.1.1 General: Vented floor furnaces, vented wall furnaces and room heaters shall conform to the listing, design, installation and maintenance requirements of 527 CMR or 248 CMR and otherwise shall be installed in accordance with applicable requirements of 780 CMR 36 and the manufacturer's listing/installation instructions.

> **Exception**: Solid fuel burning appliances shall conform to the requirements of 780 CMR 3610.

3616.1.2 Clearances: Vented floor furnaces, vented wall furnaces and room heaters shall be installed in accordance with clearance installation requirements of 527 CMR or 248 CMR and otherwise installed in accordance with the applicable requirements of 780 CMR 36 and the manufacturer's listing /installation requirements.

3616.1.3 Location: Location of vented floor furnaces, vented wall furnaces and room heaters shall conform to the requirements of 527 CMR or 248 CMR and otherwise be installed in accordance with the applicable requirements of 780 CMR 36 and the manufacturer's listing/installation requirements.

3616.1.4 Access: Access to vented floor furnaces, vented wall furnaces and room heaters shall be in accordance with the requirements of 527 CMR or 248 CMR and otherwise shall be provided in accordance with the applicable requirements of 780 CMR 36 and the manufacturer's listing /installation requirements.

3616.1.5 Installation: Vented floor furnace, vented wall furnace and room heater installations shall conform to the requirements of 527 CMR or 248 CMR and otherwise conform with the applicable requirements of 780 CMR 36 and the manufacturer's listing/installation requirements.

780 CMR 3616.2 VENTED WALL FURNACES/ADDITIONAL REQUIREMENTS

3616.2.1 Location: The location of vented wall furnaces falling under the jurisdiction of 780 CMR 3616.1.6 shall conform to the following requirements:

1. Vented wall furnaces shall be located not less than six inches (153 mm) from adjoining walls at inside corners.
2. Vented wall furnaces shall not be located where a door can swing within 12 inches (305 mm) of the furnace air inlet or outlet and shall not be installed less than 18 inches (457 mm) below overhead projections.

3616.2.2 Installation: Vented wall furnace installations shall conform to the following requirements:

1. Required wall thicknesses shall be in accordance with the manufacturer's installation instructions.
2. Ducts shall not be attached to a wall furnace. Casing extensions or boots shall only be installed when listed as part of a listed and labeled appliance.

780 CMR 3616.3 VENTED ROOM HEATERS/ADDITIONAL REQUIREMENTS

3616.3.1 Location: A room heater shall be placed so as not to cause a hazard to walls, floors, curtains and drapes, or to the free movement of persons.

3616.3.2 Installation: Room heaters shall be installed on noncombustible floors or on approved *floor protectors* for combustible floors (see 780 CMR 3610). Such *floor protectors* shall be constructed of noncombustible materials. The noncombustible floor or *floor protector* shall extend at least 16" beyond the appliance on all sides unless the room heater manufacturer has listing/installation requirements that allow for less than an 18" extension.

3616.3.3 Solid-fuel-burning heaters. See 780 CMR 3616.10.

NON-TEXT PAGE

VENTILATION AIR SUPPLY

3617.1.1 Ventilation required: General building ventilation shall be in accordance with 780 CMR 3603.6 unless specific appliance ventilation requirements impose greater ventilation criteria on a building space, in which case the ventilation criteria, as dictated by appliance requirements shall apply.

NON-TEXT PAGE

EXHAUST SYSTEMS

780 CMR3618.1 CLOTHES DRYER EXHAUST

3618.1.1 General: Dryer vent systems shall be independent of all other systems and shall convey the moisture to the outdoors - no dryer vent shall terminate in the interior space of a building unless such dryer system is listed for such application and has been approved by the BBRS if necessary; additionally, the following criteria shall be satisfied:

1. Gas fired clothes dryers shall be installed in accordance with the requirements of 248 CMR, and such exhaust vent systems shall also have a backdraft damper located on the building interior side of the vent termination unless otherwise prohibited by listing or by 248 CMR;
2. For clothes dryers generally, vents shall not be connected with sheet-metal screws or fastening means which extend into the vent. Exhaust vents shall be equipped with a backdraft damper. Vents shall be constructed of minimum 0.016-inch-thick (0.406 mm) rigid metal ducts, having smooth interior surfaces with joints running in the direction of air flow, except that;
3. Approved flexible duct connectors may be used in connection with domestic dryer exhausts unless otherwise prohibited by equipment listing or 248 CMR. Flexible duct connectors shall not be concealed within construction.

3618.1.2 Exhaust vent size: The minimum diameter of the exhaust vent shall be in accordance with 780 CMR 3618.1.3, but shall be at least the diameter of the appliance outlet.

3618.1.3 Length limitation: The maximum length of a four-inch (102 mm) diameter exhaust vent shall not exceed 25 feet (7620 mm) from the dryer location to wall or roof termination, and shall terminate with a full opening exhaust hood. A reduction in maximum length of 2.5 feet (762 mm) for each 45-degree bend and five feet (1524 mm) for each 90-degree bend shall apply. Installations when this length is exceeded shall be installed in accordance with the manufacturer's installation instructions.

780 CMR 3618.2 RANGE HOODS

3618.2.1 General: Gas-fired appliances shall conform to the requirements of 248 CMR and otherwise all range hoods shall be vented to the outdoors by a single-wall duct constructed of galvanized steel, stainless steel or copper. The duct serving the hood shall have a smooth interior surface, be substantially air tight and shall be equipped with a backdraft damper. Vents serving range hoods shall not terminate in an attic or crawl space or areas inside the building but shall vent directly to the building exterior.

> **Exception**: Listed labeled unvented range hoods shall be allowed and shall be installed in accordance with the terms of their listing.

780 CMR 3618.3 INSTALLATION OF MICROWAVE OVENS

3618.3.1 Installation of microwave oven over a cooking appliance: The installation of a listed and labeled cooking appliance or microwave oven over a listed and labeled cooking appliance shall conform to the terms of the upper appliance's listing and label and the manufacturer's installation instructions.

780 CMR 3618.4 OVERHEAD VENTILATING HOODS

3618.4.1 General: Gas-fired appliances shall conform to the requirements of 248 CMR and otherwise domestic open-top broiler units shall be provided with a metal ventilating hood, not less than 28 gage, with a clearance of not less than ¼ inch (6.4 mm) between the hood and the underside of combustible material or cabinets. A clearance of at least 24 inches (610 mm) shall be maintained between the cooking surface and the combustible material or cabinet. The hood shall be at least as wide as the broiler unit and shall extend over the entire unit.

> **Exception**: Broiler units incorporating an integral exhaust system, and listed and labeled for use without a ventilating hood, need not be provided with a ventilating hood.

NON-TEXT PAGE

DUCT SYSTEMS

780 CMR 3619.1 DUCT CONSTRUCTION

3619.1.1 Materials - duct construction: Ducts and duct materials used for a duct serving heating and cooling equipment shall be fabricated in accordance with the provisions of 780 CMR 3619.1.

3619.1.1.1 Above ground duct systems: Above ground duct systems shall conform to the following:

1. Equipment connected to duct systems shall have a 250°F (121°C) temperature limit control.
2. Factory-made air ducts shall be constructed of Class 1 or Class 2 materials as designated in Table 3619.1.1a. Class 2 materials shall not be used for ducts located within the first three feet (914 mm) of the bonnet, plenum or casing of the heating unit.
3. Minimum thicknesses of metal duct material shall be listed in Table 3619.1.1b. Galvanized steel shall conform to ASTM A 525.
4. Gypsum products may be used as ducts or plenums, provided that the air temperature does not exceed 125°F (52°C) and exposed surfaces are not subject to condensation.
5. Return ducts, except those portions directly above the heating surface or closer than two feet (610 mm) to the heating unit casing, shall be constructed of materials having a flame-spread rating not greater than 200.
6. Structural areas between studs or partitions to be used as return ducts shall be isolated from unused spaces with tight-fitting stops of sheet metal, or with wood not less than 2-inch (51 mm) nominal thickness.

3619.1.1.2 Underground duct systems. Underground duct systems shall be constructed of approved concrete, clay, metal or plastic. The maximum duct temperature for plastic ducts shall not be greater than 150°F (66°C). Plastic pipe and fittings shall conform to cell classification 12454-B of ASTM D 1248 or ASTM D 1784, and external loading properties of ASTM D 2412.

3619.1.2 Factory-made ducts: Factory-made air ducts or duct material shall be approved for the use intended, and shall be installed in accordance with the manufacturer's installation instructions. Each portion of a factory-made air duct system shall bear a listing and label indicating compliance with UL 181 and UL 181A.

3619.1.2.1 Duct insulation materials: Duct insulation materials shall conform to the following requirements:

1. Duct insulation shall comply with the energy conservation requirements of 780 CMR 3603.21.;
2. Duct coverings and linings shall have a flame-spread rating not greater than 25, and a smoke-developed rating not greater than 50.
3. Duct coverings and duct linings shall withstand a test temperature of 250°F (121°C) minimum.
4. Blanket insulation and factory-insulated flexible duct shall be labeled with the R-value, flame-spread rating, and smoke-developed rating.

3619.1.2.2 Vibration isolators: Vibration isolators installed between mechanical equipment and metal ducts shall be fabricated from approved materials and shall not exceed ten inches (254 mm) in length.

3619.1.3 Installation: Duct installation shall comply with 780 CMR 3619.1.3.1 through 3619.1.3.8.

3619.1.3.1 Duct sizing: Supply and return ducts shall be sized according to ACCA Manual D or SMACNA Installation Standards for Residential Heating and Air Conditioning Systems or other approved methods.

3619.1.3.2 Joints and seams. Joints of duct systems shall be made substantially air tight by means of tapes, mastics or gasketing. Crimp joints for round ducts shall have a contact lap of at least 1½ inches (38 mm) and shall be mechanically fastened by means of at least three sheet metal screws equally spaced around the joint.

TABLE 3619.1.1a
CLASSIFICATION OF FACTORY-MADE AIR DUCTS

DUCT CLASS	MAXIMUM FLAME SPREAD RATING
0	0
1	25
2	50

TABLE 3619 1.1b
GAGES OF METAL DUCTS AND PLENUMS USED FOR HEATING OR COOLING

TYPE OF DUCT	SIZE (INCHES)	NOMINAL THICKNESS (inches)	EQUIVALENT GALVANIZED SHEET GAGE	APPROXIMATE ALUMINUM B. & S. GAGE
Round ducts and enclosed rectangular ducts	14 or less	0.016	30	26
	over 14	0.019	28	24
Exposed rectangular ducts	14 or less	0.019	28	24
	over 14	0.022	26	22

For SI: 1 inch = 25.4 mm.

3619.1.3.3 Support: Metal ducts shall be supported by one-inch (2mm) by 18-gage metal straps, 12-gage galvanized wire at intervals not exceeding ten feet (3048 mm). Nonmetallic ducts shall be supported in accordance with the manufacturer's installation instructions.

3619.1.3.4 Firestopping: Duct installations shall be firestopped in accordance with 780 CMR 3606.2.7.

3619.1.3.5 Duct insulation: Duct insulation shall be installed in accordance with the following requirements:

1. All ductwork shall be insulated in accordance with 780 CMR 3603.21.
2. Vapor retarders with a maximum permeance of 0.05 perm [(2.87 ng/(s m2 Pa)], or aluminum foil with a minimum thickness of two mils (0.051 mm), shall be installed on cooling supply ducts that pass through nonconditioned spaces conducive to condensation.
3. Exterior ducts shall be protected with weatherproof covering capable of ultraviolet (UV) protection.
4. Duct coverings shall not penetrate a firestopped wall or floor.

3619.1.3.6 Ducts in slabs: Ducts shall be listed and labeled for underground installation. Metallic ducts not having an approved protective coating shall be completely encased in a minimum of two inches (51 mm) of concrete. Metallic ducts having an approved protective coating and nonmetallic ducts shall be installed in accordance with the manufacturer's installation instructions.

3619.1.3.7 Factory-made air ducts: Factory-made air ducts shall not be installed in or on the ground, in tile or metal pipe, or within masonry or concrete.

3619.1.3.8 Metal duct separation: Metal ducts shall be installed with at least four inches (102 mm) separation from earth.

3619.1.4 Under-floor plenums: An under-floor space used as a supply plenum shall conform to the requirements of 780 CMR 3619.1.4. Fuel gas lines and plumbing waste cleanouts shall not be located within the space.

3619.1.4.1 General: The space shall be cleaned of loose combustible materials and scrap, and shall be tightly enclosed. The ground surface of the space shall be covered with a moisture barrier having a minimum thickness of four mils (0.102 mm).

3619.1.4.2 Materials: The under-floor space, including the sidewall insulation, shall be formed by materials having flamespread ratings not greater than 200.

3619.1.4.3 Furnace connections: A duct shall extend from the furnace supply outlet to not less than sixinches (153 mm) below the combustible framing. This duct shall comply with the provisions of 780 CMR 3616.2.1. A noncombustible receptacle shall be installed below the floor opening into the plenum in accordance with the following requirements:

1. The receptacle shall be securely suspended from the floor members and shall not be more than 18 inches (457 mm) below the floor opening.
2. The area of the receptacle shall extend three inches (76 mm) beyond the opening on all sides.
3. The perimeter of the receptacle shall have a vertical lip at least one inch (25 mm) high at the open sides.

3619.1.4.4 Access: Access to an under-floor plenum shall be provided through an opening in the floor with minimum dimensions of 18 inches by 24 inches (457 mm by 610 mm).

3619.1.4.5 Furnace controls: Furnace controls shall conform to the applicable requirements of 527 CMR or 248 CMR

Exception: For solid fuel burning appliances see 780 CMR 3610.

780 CMR 3619.2 RETURN AIR

3619.2.1 Return air: Return air shall be taken from inside the dwelling, but may be diluted with outdoor air.

3619.2.2 Required area: The total unobstructed area of return ducts or openings to a warm-air furnace shall be in accordance with the manufacturer's installation instructions, but not less than two square inches (1290 mm^2) for each 1,000

Btu/h (293 W) input rating of the furnace. The minimum unobstructed total area of the return air ducts or openings to a central air-conditioning unit and/or heat pump shall be in accordance with the manufacturer's installation instructions, but shall not be less than six square inches (3870 mm^2) for each 1,000 Btu/h (293 W) nominal cooling output rating.

3619.2.3 Prohibited sources: Return air for a warm-air furnace shall not be taken from bathrooms, kitchens, garages or other dwelling units. Outdoor air shall not be taken from within ten feet (3048 mm) of an appliance or plumbing vent outlet that is located less than three feet (914 mm) above the air inlet.

3619.2.4 Inlet opening protection: Outdoor air inlets shall be covered with screen having no less than ¼-inch (6.4 mm) openings and no greater than ½-inch (12.7 mm) openings.

780 CMR 3619.3 - SUPPLY AIR

3619.3.1 General: The minimum unobstructed total area of supply ducts from a warm-air furnace shall be in accordance with the manufacturer's installation instructions, but shall not be less than two square inches (1290 mm^2) for each 1,000 Btu/h (293 W) input rating of the furnace. The minimum unobstructed total area of the supply air ducts from a central air-conditioning unit and/or heat pump shall be in accordance with the manufacturer's installation instructions, but shall not be less than six square inches (3870 mm^2) for each 1,000 Btu/h (293 W) nominal cooling output rating. Dampers, grilles or registers installed for the purpose of controlling the supply airflow shall not be considered as obstructions.

NON-TEXT PAGE

COMBUSTION AIR

3620.1 General: Combustion air requirements of 780 CMR 3620 are intended to apply only when the requirements of 248 CMR or 527 CMR, as applicable, do not apply.

3620.1.1 Air supply: Fuel-burning equipment shall be provided with a supply of air for fuel combustion, draft hood dilution and ventilation of the space in which the equipment is installed. The methods of providing combustion air in this chapter do not apply to direct vent appliances, listed cooking appliances, refrigerators and domestic clothes dryers.

3620.1.1.1 Buildings of unusually tight construction: In buildings of unusually tight construction, combustion air shall be obtained from outside the sealed thermal envelope. In buildings of ordinary tightness insofar as infiltration is concerned, all or a portion of the combustion air for fuel-burning appliances may be obtained from infiltration when the room or space has a volume of 50 cubic feet per 1,000 Btu/h (4.83 L/W) input.

3620.1.2 Exhaust and ventilation system: Air requirements for operation of exhaust fans, kitchen ventilation systems, clothes dryers, and fireplaces shall be considered in determining the adequacy of a space to provide combustion air.

3620.1.3 Volume dampers prohibited: Volume dampers shall not be installed in combustion air openings.

3620.1.4 Prohibited sources: Combustion air ducts and openings shall not connect appliance enclosures with space in which the operation of a fan may adversely affect the flow of combustion air. Combustion air shall not be obtained from an area in which flammable vapors present a hazard.

3620.1.5 Opening area: The free area of each opening shall be used for determining combustion air. Unless otherwise specified by the manufacturer or determined by actual measurement, the free area shall be considered 75% of the gross area for metal louvers and 25% of the gross area for wood louvers.

3620.2 All air from inside the building, general: The requirements of 780 CMR 3620.2.1 through 3620.2.3 shall apply when all combustion air is taken from inside the building.

Note: also see 780 CMR 3610, generally, for fireplaces and solid fuel-burning appliances.

3620.2.1 Required volume: If the volume of the space in which fuel-burning appliances are installed is greater than 50 cubic feet per 1 ,000 Btu/h (4.83 L/W) of aggregate input rating in buildings of ordinary tightness insofar as infiltration is concerned, normal infiltration shall be regarded as adequate to provide combustion air. Rooms communicating directly with the space in which the appliances are installed through openings not furnished with doors shall be considered part of the required volume.

3620.2.2 Confined space: Where the space in which the appliance is located does not meet the criterion specified in 780 CMR 3620.2.1, two permanent openings to adjacent spaces shall be provided so that the combined volume of all spaces meets the criterion. One opening shall be within 12 inches (305 mm) of the top and one within 12 inches (305 mm) of the bottom of the space, as illustrated in Figure 3620.2.2. Each opening shall have free area equal to a minimum of one square inch per 1,000 Btu/h (2.20 mm2/W) input rating of all appliances installed within the space, but not less than 100 square inches (0.064 m^2).

3620.2.3 Unusually tight construction: If the space is of adequate volume in accordance with 780 CMR 3620.2.1 or 3620.2.2, but is within a building sealed so tightly that infiltration air is not adequate for combustion, combustion air shall be obtained from outdoors or from spaces freely communicating with the outdoors in accordance with 780 CMR 3620.3 or 3620.4.

3620.3 All combustion air from outside the building, general: The requirements of 780 CMR 3620.3.1 through 3620.3.5 shall apply when all combustion air is taken from outside the building.

3620.3.1 Outdoor air: When the space in which fuel-burning appliances are located does not meet the criterion for indoor air specified in 780 CMR 3620.2, outside combustion air shall be supplied through openings or ducts, as illustrated in Figures 3620.3.1, 3620.3.3a, 3620.3.3b and 3620.4. One opening shall be within 12 inches (305 mm) of the top of the enclosure, and one within 12 inches (305 mm) of the bottom of the enclosure. Openings are permitted to connect to spaces directly communicating with the outdoors, such as ventilated crawl spaces or ventilated attic spaces. The same duct or opening shall not serve both combustion air openings. The duct serving the upper opening shall be level or extend upward from the appliance space.

3620.3.2 Size of opening: When communicating with the outdoors by means of vertical ducts, each opening shall have a free area of at least one square inch per 4,000 Btu/h (0.550 mm^2/W) of total input rating of all appliances in the space. If horizontal ducts are used, each opening shall have a free area of at least one square inch per 2,000 Btu/h (1.10 mm^2/W) of total input of all appliances in the space. Ducts shall be of the same minimum cross-sectional area as the required free area of the openings to which they connect. The minimum cross-sectional dimension of rectangular air ducts shall be three inches (76 mm).

3620.3.3 Attic combustion air: Combustion air obtained from an attic area, as illustrated in Figure 3620.3.3a, shall be in accordance with the following:

1. The attic ventilation shall be sufficient to provide the required volume of combustion air.
2. The combustion air opening shall be provided with a metal sleeve extending from the appliance enclosure to at least six inches (153 mm) above the top of the ceiling joists and ceiling insulation.
3. An inlet air duct within an outlet air duct shall be an acceptable means of supplying attic combustion air to an appliance room provided that the inlet duct extends at least 12 inches (305 mm) above the top of the outlet duct in the attic space, as illustrated in Figure 3620.3.3b.
4. The end of ducts that terminate in an attic shall not be screened.

3620.3.4 Under-floor combustion air: Combustion air obtained from under-floor areas, as illustrated in Figure 3620.3.4, shall have a free opening area to the outside equivalent to not less than twice the required combustion air opening.

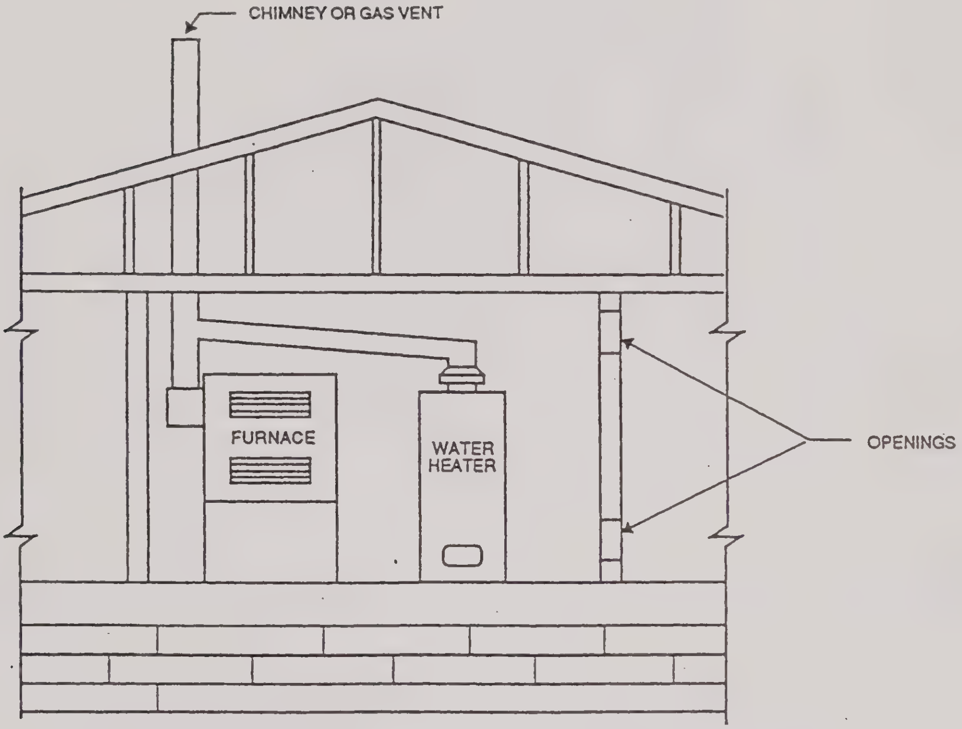
3620.3.5 Opening requirements: Outside combustion air openings shall be covered with corrosion-resistant screen or equivalent protection having no less than ¼-inch (6.4 mm) openings, and not greater than ½-inch (12.7 mm) openings.

3620.4 Combined use of indoor and outdoor air for combustion, general: The requirements of 780 CMR 3620.4.1 through 3620.4.2 shall apply when required combustion air consists of both indoor and outdoor air.

3620.4.1 Supply method: When the space in which fuel-burning appliances are located does not meet the criterion for indoor air specified in 780 CMR 3620.2, combustion air supplied by a combined use of indoor and outdoor air shall be supplied through openings and ducts extending to the appliance room or to the vicinity of the appliance.

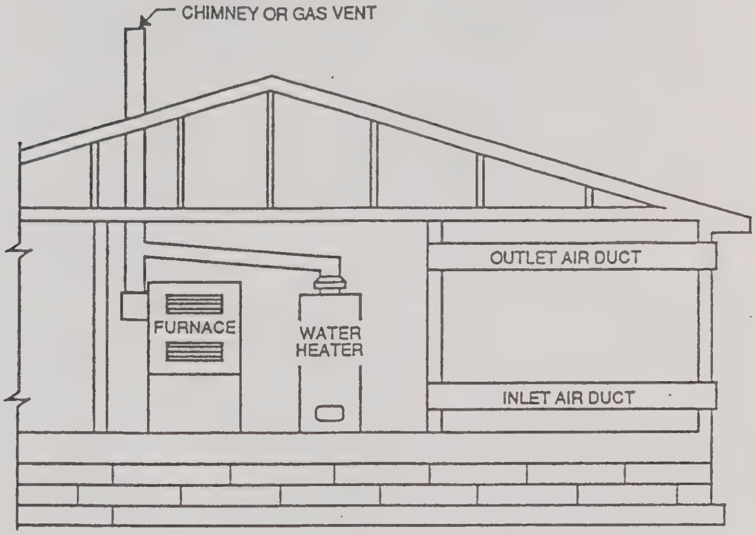
3620.4.2 Openings and supply ducts: Two openings for ventilation shall be located and sized in accordance with 780 CMR 3620.2.2. In addition, there shall be one opening directly communicating with the outdoors or to such spaces (crawl space or attic) that freely communicates with the outdoors. This opening shall have free area of at least one square inch per 5,000 Btu/h (0.440 mm^2/W) of total input of all appliances in the space. Ducts shall be of the same minimum cross-sectional area as the required free area of the opening. Ducts admitting outdoor air may be connected to the return air side of the heating system.

Figure 3620.2.2
EQUIPMENT LOCATED IN CONFINED SPACES -
ALL AIR FROM ADJACENT SPACES WITHIN THE BUILDING



For SI: 1 square inch = 645.16 mm^2, 1 Btu/h = 0.2931 W.
NOTE: Each opening shall have a free area of not less than one square inch per 1,000 Btu/h of the total input rating of all equipment in the enclosure, but not less than 100 square inches.

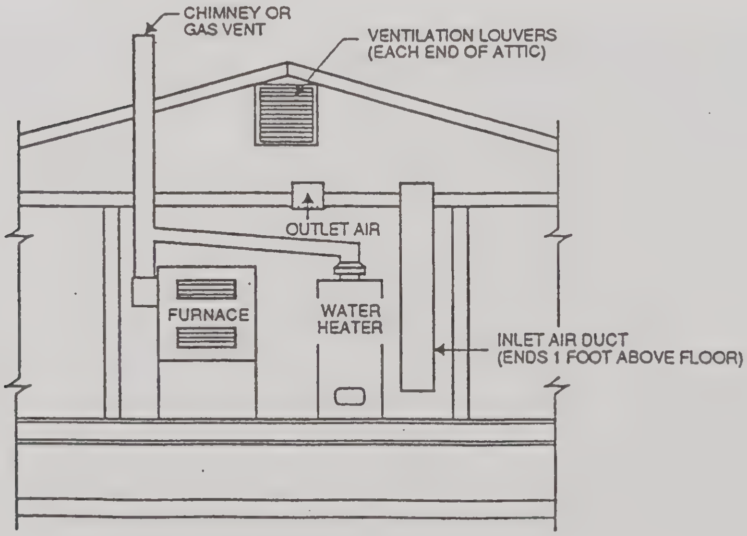
Figure 3620.3.1
EQUIPMENT LOCATED IN CONFINED SPACES -
ALL AIR TAKEN FROM OUTDOORS


CHIMNEY OR GAS VENT
FURNACE
WATER HEATER
OUTLET AIR DUCT
INLET AIR DUCT

For SI: 1 Btu/h = 0.2931 W.

NOTES: Each air duct opening shall have a free area of not less than one square inch per 2,000 Btu/h of the total input rating of all equipment in the enclosure.

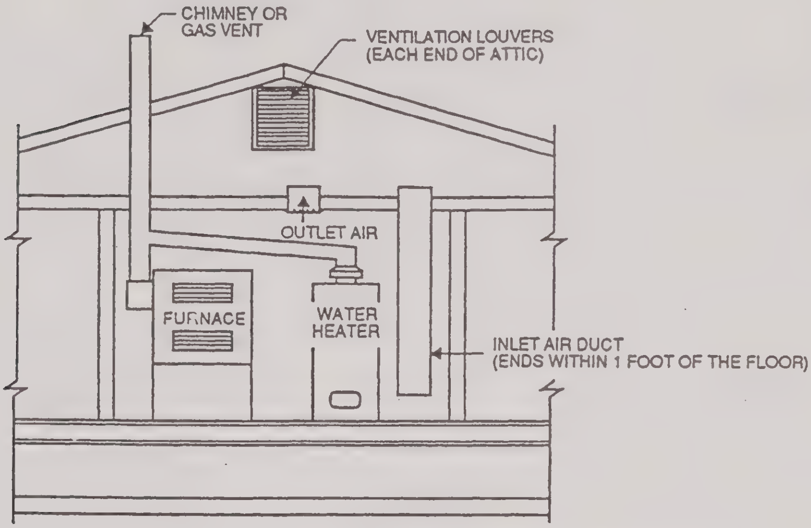
FIGURE 3620.3.3a
EQUIPMENT LOCATED IN CONFINED SPACES -
ALL AIR FROM OUTDOORS THROUGH VENTILATED ATTIC


CHIMNEY OR GAS VENT
VENTILATION LOUVERS (EACH END OF ATTIC)
OUTLET AIR
FURNACE
WATER HEATER
INLET AIR DUCT (ENDS 1 FOOT ABOVE FLOOR)

For SI: 1 inch = 25.4 mm, 1 square inch = 645.16 mm^2, 1 Btu/h = 0.2931 W.

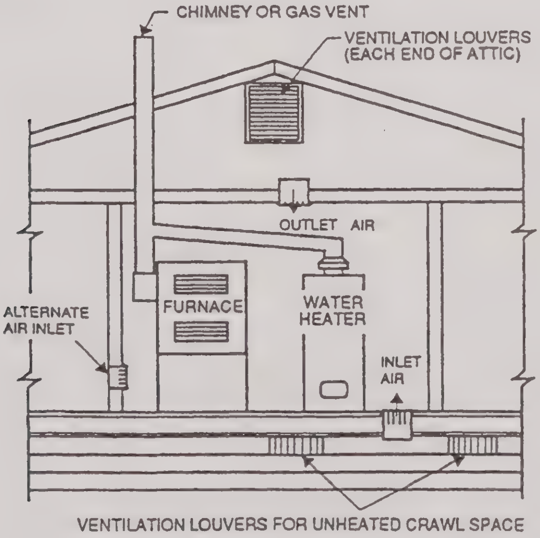
NOTE: The inlet and outlet air openings shall each have a free area of not less than one square inch per 4,000 Btu/h of the total input rating of all equipment in the enclosure.

Figure 3620.3.3b
EQUIPMENT LOCATED IN CONFINES SPACES - ALL AIR FROM OUTDOORS THROUGH VENTILATED ATTIC
(Alternative Method)


CHIMNEY OR GAS VENT
VENTILATION LOUVERS (EACH END OF ATTIC)
OUTLET AIR
FURNACE
WATER HEATER
INLET AIR DUCT (ENDS WITHIN 1 FOOT OF THE FLOOR)

For SI: 1 inch = 25.4 mm, 1 square inch = 645.16 mm^2, 1 Btu/h = 0.2931 W.
NOTE: The inlet and outlet air openings shall each have a free area of not less than one square inch per 4,000 Btu/h of the total input of all equipment in the enclosure.

Figure 3620.4
EQUIPMENT LOCATED IN CONFINED SPACES - INLET AIR FROM VENTILATED CRAWL SPACE AND OUTLET AIR TO VENTILATED ATTIC


CHIMNEY OR GAS VENT
VENTILATION LOUVERS (EACH END OF ATTIC)
OUTLET AIR
ALTERNATE AIR INLET
FURNACE
WATER HEATER
INLET AIR
VENTILATION LOUVERS FOR UNHEATED CRAWL SPACE

For SI: 1 square inch = 645.16 mm^2, 1 Btu/h = 0.2931 W.
NOTE: The inlet and outlet air openings shall each have a free area of not less than one square inch per 4,000 Btu/h of the total input of all equipment in the enclosure.

NON-TEXT PAGE

CHIMNEYS AND VENTS

3621.1 GENERAL

NOTE: The requirements of 780 CMR 3621 are to be recognized in conjunction with applicable requirements of 248 CMR and/or 527 CMR for gas-fired and oil-fired appliances respectively; also note that 248 CMR is enforced by Gas Inspectors and 527 CMR is enforced by the Heads of Fire Departments.

3621.1.1 Vent required: Fuel-burning appliances shall be vented to the outside in accordance with their listing and label and manufacturer's installation instructions. Venting systems shall consist of approved chimneys or vents, or venting assemblies which are integral parts of labeled appliances.

3621.1.2 Draft requirements: A venting system shall satisfy the draft requirement of the equipment in accordance with the manufacturer's installation instructions and shall be constructed and installed to develop a positive flow to convey combustion products to the outside atmosphere.

3621.1.3 Inspection of chimneys: Before connecting a vent connector to a chimney, the chimney passageway shall be cleaned and free of obstructions. When inspection reveals that an existing chimney is not safe for the intended application, it shall be rebuilt to conform to 780 CMR 3610.2 if the chimney is a masonry chimney (or applicable requirements of 248 CMR or 527 CMR), lined or relined with an approved liner, or replaced with an approved vent or chimney.

3621.1.4 Mechanical draft systems: A mechanical draft system shall be used only with equipment listed and labeled for such use. Provision shall be made to prevent the flow of fuel to the equipment when the draft system is not operating. Forced draft systems and all portions of induced draft systems under positive pressure during operation shall be designed and installed so as to prevent leakage of flue gases into a building.

3621.1.5 Direct vent appliances: *Direct vent* appliances shall be listed and labeled and shall be installed in accordance with the manufacturer's installation instructions

3621.1.6 Support: Venting systems shall be adequately supported for the weight of the material used.

3621.1.7 Duct penetrations: Vents or vent connectors shall not extend into or through supply and return air ducts or plenums.

3621.1.8 Firestopping: Vent and chimney installations shall be firestopped in accordance with 780 CMR 3606.2.7.

3621.1.9 Unused openings: Unused openings in any venting system shall be closed or capped.

780 CMR 3621.2 - VENT COMPONENTS

3621.2.1 Draft hoods: Unless otherwise allowed by 248 CMR or 527 CMR as applicable, draft hoods shall be located in the same room or space as the combustion air openings for the appliances.

3621.2.2 Vent dampers: Vent dampers shall comply with 780 CMR 3621.2.2.1 and 3621.2.2.2.

3621.2.2.1 Manually operated: Unless otherwise allowed by 248 CMR or 527 CMR as applicable, manually operated dampers shall not be installed except in connectors or chimneys of solid fuel-burning appliances.

3621.2.2.2 Automatically operated: Automatically operated dampers shall be installed in accordance with the requirements of 248 CMR or 527 CMR if applicable and otherwise in accordance with the terms of their listing and label and the manufacturer's requirements and shall be installed to prevent firing of the burner unless the damper is opened to a safe position. Automatic dampers shall conform to ANSI Z21.66.

3621.2.3 Draft regulators: For oil-fired appliances required to be connected to a chimney, draft regulators shall be provided as required by 527 CMR. Draft regulators provided for solid-fuel-burning appliances to reduce draft intensity shall be installed and set in accordance with the manufacturer's installation and operation requirements.

3621.2.3.1 Location: When required by 248 CMR or 527 CMR or the manufacturer's installation/operation requirements, draft regulators shall be installed in the same room or enclosure as the appliance such that no difference in pressure between the air at the regulator and the combustion air supply will exist.

780 CMR 3621.3 CHIMNEY AND VENT CONNECTORS

3621.3.1 Chimney and vent connectors: Connectors shall be used to connect fuel-burning appliances to a vertical chimney or vent unless the chimney or vent is attached directly to the appliance.

3621.3.2 Connectors for gas appliances: See 248 CMR

3621.3.3 Connectors for oil and solid fuel appliances: For connector requirements for oil-fired appliances, see 527 CMR. For solid fuel-burning appliances, connectors compatible with the listed appliance shall be utilized and may include, but not be limited to factory-built chimney material, Type L vent material, Type PL vent material or single-wall metal pipe having resistance to corrosion and heat, and thickness not less than that of galvanized steel as specified in Table 3621.3.3.

Table 3621.3.3
THICKNESS FOR SINGLE-WALL METAL PIPE CONNECTORS

Diameter of Connector (in)	Sheet Metal Gage Number
Less than 6	26
6 to 10	24

For SI: 1 inch = =25.4 mm

3621.3.4 Installation: Unless otherwise permitted by 248 CMR or 527 CMR, if applicable, the following requirements shall be met: vent and chimney connectors shall be installed in accordance with the appliance manufacturer's installation instructions and within the space that the appliance is located. Appliances shall be located as close as practical to the vent or chimney. Connectors shall be as short and straight as possible and installed with a rise of not less than ¼ inch (6.4 mm) to the foot run. Connectors shall be securely supported and joints shall be fastened with sheet metal screws and rivets. Devices that obstruct the flow of flue gases shall not be installed in a connector unless listed and labeled or approved for such installations.

3621.3.4.1 Location: When the connector serving a gas appliance with a draft hood is located in nonconditioned space, that portion of the connector shall conform to the requirements of 248 CMR.

3621.3.4.2 Floors ceiling and wall penetrations: A chimney connector or vent connector shall not pass through any floor, ceiling, wall, or partition unless the connector is listed and labeled for wall pass-through, or is routed through a device listed and labeled for wall pass-through and is installed in accordance with the conditions of its listing and label. Connectors for listed and labeled gas appliances with draft hoods, and oil-fired appliances listed and labeled for Type L vents, passing through walls or partitions shall be in accordance with the following:

1. Type B or Type L vent material for gas appliances and Type L vent material for oil appliances shall be installed with not less than listed and labeled clearances to combustible material.
2. Single-wall metal pipe shall be guarded by a ventilated metal thimble not less than four inches (102 mm) larger in diameter than the vent connector.

3621.3.4.3 Length: Unless otherwise permitted by 248 CMR or 527 CMR, if applicable, the horizontal run of an uninsulated connector to a natural draft chimney shall not exceed 75% of the height of the vertical portion of the chimney above the connector. The horizontal run of a listed connector to a natural draft chimney shall not exceed 100% of the height of the vertical portion of the chimney above the connector.

3621.3.4.4 Size: A connector shall not be smaller than the flue collar of the appliance.

Exception: When the appliance is otherwise listed for such connector application and the respective requirements of 248 CMR or 527 CMR, if applicable, so allow.

3621.3.4.5 Clearance: Connectors shall be installed with clearance to combustibles as set forth in NFPA 211, Section 6-5.1. Reduced clearances to combustible material shall be in accordance with NFPA 211, Section 6-5.1.2.

3621.3.4.6 Access: The entire length of a connector shall be accessible for inspection, cleaning and replacement.

3621.3.4.7 Fireplace connection: An appliance shall not be connected to a chimney flue serving a fireplace unless the fireplace opening is sealed or the chimney flue which vents the fireplace is permanently sealed below the connection. (Also see 780 CMR 3610.6.5.2).

780 3621.4 VENTS

3621.4.1 Type of vent required: Gas-fired and oil-fired appliances shall be vented in accordance with 248 CMR or 527 CMR as applicable. Solid fuel-burning appliances shall be vented in accordance with the requirements of 780 CMR 3610.6.5.2 and 3610.6.6 and additionally in accordance with their listing and manufacturer's requirements, as applicable.

3621.4.2 Termination: Vent termination shall comply with 780 CMR 3621.4.2.1 and 3621.4.2.6.

3621.4.2.1 Through the roof: Vents passing through a roof shall extend through flashing and terminate in accordance with the manufacturer's installation requirements.

3621.4.2.2 Natural draft appliances: Vents for natural draft fossil fuel-fired appliances shall terminate at heights above the highest connected appliance in accordance with the requirements of 248 CMR or 527 CMR as applicable, otherwise such vents shall terminate at least five feet (1524 mm) above the highest connected appliance outlet, and natural draft gas vents serving wall furnaces shall terminate at an elevation at least 12 feet (3658 mm) above the bottom of the furnace. Also see 780 CMR 3610 generally.

3621.4.2.3 Type B or BW vent: See 248 CMR.

3621.4.2.4 Type L vent: For oil-fired appliances, see 527 CMR (in the absence of guidance from 527 CMR, such vents shall terminate not less than 2 feet (610 mm) above any portion of the building within ten feet (3048 mm)).

3621.4.2.5 Direct vent appliances: See 248 CMR or 527 CMR if applicable, otherwise, the vent terminal of a direct vent appliance with an input of 50,000 Btu/h (14 655 W) or less shall be located not less than nine inches (229 mm) from any opening through which vent gases could enter a building. The vent terminal of a direct vent appliance having an input exceeding 50,000 Btu/h (14 655 W) shall be located not less than 12 inches (305 mm) from the opening. The bottom of a vent terminal and an air intake shall be located at least 12 inches (305 mm) above grade and in all cases shall comply to manufacturer's installation requirements when such requirements exceed the criteria of 780 CMR 3621.4.2.5.

3621.4.2.6 Mechanical draft systems: Mechanical draft systems other than direct vent systems shall be installed in accordance with 248 CMR or 527 CMR if applicable, otherwise such systems shall be installed in accordance with their listing and the manufacturer's installation requirements.

3621.4.3 Installation: Type B, Type BW and Type L vents shall be installed in accordance with the applicable requirements of 248 CMR or 527 CMR and otherwise in accordance with the terms of their listing and label and the manufacturer's installation instructions. For venting systems for listed and labeled Category II, 111 and IV gas appliances, see 248 CMR and the manufacturer's installation instructions.

3621.4.3.1 Size of single appliance venting systems: Except as otherwise allowed by 248 CMR or 527 CMR as applicable, an individual vent for a single appliance shall have a cross-sectional area equal to or greater than the area of the connector to the appliance, but not less than seven square inches (45 15 mm^2) except where the vent is an integral part of a listed and labeled appliance. Also see 780 CMR 3610 generally.

3621.4.3.2 Size of multiple-appliance venting systems. For gas-fired and oil-fired appliances, see 248 CMR or 527 CMR as applicable. For other appliances see 780 CMR 3610 generally.

Note 1: Connectors serving appliances operating under natural draft shall not be connected into any portion of a mechanical draft system operating under positive pressure.

Note 2: Solid fuel-burning appliances shall not be connected to a vent serving another appliance burning other fuels except as noted in 780 CMR 3610.6.10.

3621.4.3.3 Size of solid fuel vents: See 780 CMR 3610.6.5.2.

3621.5 MASONRY AND FACTORY-BUILT CHIMNEYS

3621.5.1 Masonry and factory-built chimneys - general: Masonry and factory-built chimneys shall be built and installed in accordance with 780 CMR 3610.

3621.5.2 Installation of factory-built chimneys: Factory-built chimneys and chimney units shall be installed in accordance with the manufacturer's installation instructions such that flue gas temperatures in the chimney shall not exceed the limits specified in their listing and label. Factory-built chimneys for use with wood-burning appliances shall be Type HT - Also see 780 CMR 3610.3.

3621.5.3 Masonry chimney connection: Unless otherwise allowed by 248 CMR or 527 CMR, if applicable: a chimney connector shall enter a masonry chimney not less than six inches (153 mm) above the bottom of the chimney, except that if six inches (153 mm) are not available, a cleanout shall be provided by installing a capped tee in the connector next to the chimney. A connector entering a masonry chimney shall extend through, but not beyond the wall and shall be flush with the inner face of the liner. Connectors, or thimbles, when used, shall be firmly cemented into the masonry.

3621.5.4 Size of masonry chimneys: The effective area of a natural draft chimney flue for one appliance shall not be less than the area of the connector to the appliance. Chimneys connected to more than one appliance shall not be less than the area of the largest connector plus 50% of the areas of additional vent connectors - also see 780 CMR 3610.2.10 and 3610.2.11.

3621.5.4.1 Size of chimney for single gas appliance: See 248 CMR.

3621.5.4.2 Size of chimney for multiple gas appliance: See 248 CMR.

SOLAR SYSTEMS

3622.1 Solar systems, general: 780 CMR 3622 provides for construction, installation, alteration, and repair of equipment and systems utilizing solar energy to provide space heating or cooling, hot water heating, and swimming pool heating.

> **NOTE 1**: Also see energy conservation provisions, 780 CMR 3603.
>
> **NOTE 2**: Solar systems shall conform to all applicable requirements of 248 CMR.

3622.2 Installation: Installation of solar energy systems shall comply with 780 CMR 3622.2.1 through 3622.2.7.

3622.2.1 Access: Solar energy collectors, controls, dampers, fans, blowers, and pumps shall be accessible for inspection, maintenance, repair, and replacement.

3622.2.2 Roof-mounted collectors: The roof shall be constructed to support the loads imposed by roof-mounted solar collectors . Roof-mounted solar collectors that serve as a roof covering shall conform to the requirements for roof coverings in 780 CMR 3609. When mounted on or above the roof coverings, the collectors and supporting structure shall be constructed of noncombustible materials or fire-retardant-treated wood equivalent to that required for the roof construction and such mounting shall be engineered to ensure proper structural support, unless the collector and mounting design satisfies the criteria set forth in Table 3622.2, including all Table notes.

3622.2.3 Pressure and temperature relief: System components containing fluids shall be protected with pressure- and temperature-relief valves. Relief devices shall be installed in sections of the system such that a section cannot be valved offor isolated from a relief device. Such pressure and.or pressure-temperature relief devices shall conform to all pertinent requirements of 248 CMR or ASME Boiler and Pressure Vessel Rules as applicable.

3622.2.4 Vacuum relief: System components that may be subjected to pressure drops below atmospheric pressure during operation or shutdown shall be protected by a vacuum-relief valve.

3622.2.5 Protection from freezing: System components shall be protected from damage by freezing of heat-transfer liquids at the lowest ambient temperatures during operation.

3622.2.6 Expansion tanks: Expansion tanks in solar energy systems shall be installed in accordance with 248 CMR and possess ASME Boiler and Pressure Vessel stamps if applicable.

3622.2.7 Roof penetrations: Roof penetrations shall be flashed and waterproofed in accordance with 780 CMR 3609.

3622.3 Labeling: Labeling shall comply with 780 CMR 3622.3.1 and 3622.3.2.

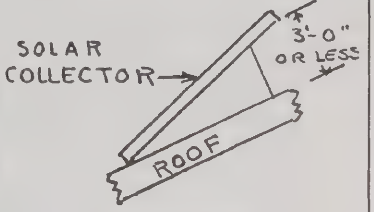
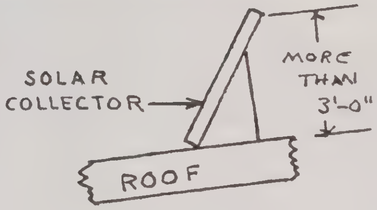
Exception: Collectors and/or thermal storage units that are site-built except such labeling that would otherwise be required by state and/or federal agencies having jurisdiction.

3622.3.1 Collectors: Collectors shall be listed and labeled to show the manufacturer's name, model, serial number, collector weight, maximum allowable temperatures and pressures, and the type of heat transfer fluids allowed

3622.3.2 Thermal storage units: Pressurized thermal storage units shall be listed and labeled to show the manufacturer's name, model, serial number, maximum and minimum allowable operating temperatures and pressures, and the type of heat transfer fluids allowed

3622.4 Prohibited heat transfer fluids: Flammable gases and liquids shall not be used as heat transfer fluids.

Table 3622.2
ALLOWABLE SPANS FOR ROOF RAFTERS SUPPORTING CERTAIN SOLAR COLLECTORS

	 CONDITION A				 CONDITION B			
Member	800 psi (spruce or better MAX SPAN		1200 psi (hemfir or better) MAX SPAN		800psi (spruce or better MAX SPAN		1299 psi (hemfir or better) MAX SPAN	
	LRC	HRC	LRC	HRC	LRC	HRC	LRC	HRC
2 x 6								
12" o.c.	9-1	8-8	11-3	10-8	7-0	6-9	8-10	8-6
16" o.c.	7-11	7-5	9-9	9-3	6-0	5-10	7-6	7-3
24" o.c.	6-8	6-0	7-11	7-5	4-10	4-9	6-0	5-10
2 x 8								
12" o.c.	12-2	11-7	15-1	14-4	9-7	9-3	12-0	11-7
16" o.c.	10-6	10-0	13-0	12-4	8-2	7-11	10-3	9-11
24" o.c.	8-6	8-1	10-6	10-0	6-5	6-3	8-2	7-11
2 x 10								
12" o.c.	15-9	14-11	19-6	18-5	12-7	12-1	15-9	15-2
16" o.c.	13-6	12-10	16-9	15-10	10-9	10-4	13-5	12-11
24" o.c.	10-11	10-5	13-6	12-10	8-6	8-3	10-8	10-4
2 x 12								
12" o.c.	19-4	18-4	23-11	22-7	15-8	15-0	19-7	18-10
16" o.c.	16-8	15-9	20-6	19-5	13-4	12-10	16-9	16-1
24" o.c.	13-5	12-9	16-7	15-9	10-8	10-3	13-4	12-10

CRITICAL NOTES TO TABLE 3622.2 ALLOWABLE SPANS FOR ROOF RAFTERS SUPPORTING SOLAR COLLECTORS

HOW TO USE TABLE 3622.2:

1. Check to determine that none of the maximum conditions listed below are exceeded (see all Notes)
   a. maximum pitch of collectors - 20:12 (60°)
   b. maximum collector weight - seven lbs. per sq. ft.
   c. maximum length of collector - nine ft.
2. Determine whether Condition A or Condition B applies.
3. Inspect roof rafters and determine their size, spacing & type of wood. (Most are hemfir or better).
4. Determine whether light roof construction (LRC-asphalt, wood shingles, etc.) or heavy roof construction (HRC-slate, tile shingles, etc.) applies.
5. Read allowable span from tables. Rafter spans are measured along the horizontal projection and loads are considered as applied on the horizontal projection.

ADDITIONAL CONSTRUCTION CRITERIA:

Provide solid blocking between each panel connection to roof. Lag bolt or through bolt panel connection to rafters or blocking.

For situations exceeding any maximum condition listed above or not shown in Condition A or B, the structure shall be approved by a licensed professional engineer or registered architect

DESIGN CRITERIA (Table 3622.2):

Strength: ten lbs per sq. ft. (Light roof construction-LRC) or 15 lbs. per sq. ft. (heavy roof construction-HRC) as noted plus 30 lbs. per sq. ft. live load plus load of drifting snow plus loads of solar collectors determine fiber stress.

Deflection: For 30 lbs. per sq. ft. live load, deflection shall be limited to span in inches divided by 180.

APPENDIX A

REFERENCED STANDARDS

Part I

The following is a listing of the standards referenced in 780 CMR, the effective date of the standard, the promulgating agency of the standard and the section(s) of 780 CMR that refer to the standard.

AA **Aluminum Association**
900 19th Street, N.W.
Suite 300
Washington, D.C. 20006

Standard reference number	Title	Referenced in 780 CMR Section number
ASM 35-80	Specification for Aluminum Sheet Metal Work in Building Construction	2002.1, 3609.5.2
SAS 30-94	Specification for Aluminum Structures	2002.1, 3608.4.3

AAMA **American Architectural Manufactures Association**
Suite 310
1540 Dundee Road
Palatine, IL 60067

Standard reference number	Title	Referenced in 780 CMR Section number
1402-86	Standard Specifications for Aluminum Siding, Soffit and Fascia	1405.3.4
101-88	Voluntary Specification for Aluminum Prime Windows and Glass Doors	3606.8.1, 3606.9.1

AASHTO **American Association of State Highway and Transportation Officials**
444 North Capitol Street, N.W.
Suite 225
Washington, D.C. 20001

Standard reference number	Title	Referenced in 780 CMR Section number
HB-15-92	Standard Specifications for Highway Bridges	1606.1.1

ACI **American Concrete Institute**
P.O. Box 19150
Detroit, Michigan 48219

Standard reference number	Title	Referenced in 780 CMR Section number
318-95	Building Code Requirements for Structural Concrete	1705.6.1, 1705.6.2, 1705.6.4 Table 1705.6.3, 1810.2, 1810.6, 1815.2.3, 1821.3.6, 1901.1, 1901.2, 1903.1, 1903.4, 1903.5.2, 1904.1, 1904.2, 1904.2.3 1906.1, 1906.2, 1906.4.2, 1906.5.1, 1906.6.1, 1906.7, 1907.1.3, 1907.1.4, 1908.1, 1908.2, 1908.2.1, 1908.3.1, 1908.3.4, 1908.5.2, 1908.8.2, 1910.1, 1910.3.1, 1910.5, 1910.6.2, 1910.6.5, 3604.4.1
336	Concrete Code	1815.4, 1815.7

Standard reference number	Title	Referenced in 780 CMR Section number
318.1-89	Building Code Requirements for Structural Plain Concrete-with 1992 Revisions.	1810.2, 1812.3.2, 1901.2, 1904.1, 1904.2, *3604.4.1*
506.2-90	Specification for Materials, Proportioning, and Application of Shortcrete	1911.9
ACI 530/ASCE 5/ TMS402-95	Building Code Requirements for Masonry Structures	707.3 1812.3.2, Table 1812.3.2, 2101.1.1, 2101.1.2, 2104.2, 2104.2.1, 2104.3, 2104.4, 2106.3.1, 3604.4.1, 3606.4.1
ACI 530.1/ ASCE6/TMS 602-95	Specifications for Masonry Structures	Table 1705.7, 2112.1.1

AFPA

American Forest and Paper Association
1111 19TH Street, NW, Suite 800
Washington, D.C. 20036

Standard reference number	Title	Referenced in 780 CMR Section number
NDS-91	(National Design) Specification for Wood Construction Design Values for Wood Construction	3608.2.2, 2312.1, 2312.4, 2313.3.1, 2313.3.2
TR-7	Basic Requirements for Permanent Wood Foundations Systems	3603.22.3.4

AHA

American Hardboard Association
520 N. Hicks Road
Palatine, Illinois 60067

Standard reference number	Title	Referenced in 780 CMR Section number
A135.4-95	Basic Hardboard	1405.3.1
A135.6-90	Hardboard Siding	1405.3.2, 2309.7, Table 3607.3.4
A194.1-85	Cellulosic Fiber Board	2309.1, Table 3606.2.3(a)

AISC

American Institute of Steel Construction, Inc.
Suite 3100
One East Wacker Drive
Chicago, Illinois 60601-2001

Standard reference number	Title	Referenced in 780 CMR Section number
ASD-89	Specification for Structural Steel Buildings - Allowable Stress Design and Plastic Design	Table 1705.5.2, 2203.1, 2203.5, 2208.1
LFRD-93	Load and Resistance Factor Design Specifications for Structural Steel Buildings	Table 1705.5.2, 2203.1, 2203.5, 2208.1
AISC-92	Seismic Provisions for Structural Steel Buildings	2203.2, 2203.2.1

AISI

American Iron and Steel Institute
Suite 1300
1010 17th Street, N.W.
Washington, D.C. 20036-4700

Standard reference number	Title	Referenced in 780 CMR Section number
AISI-73	Criteria for Structural Applications of Steel Cables for Buildings	2207.2
CFSD-ASD-86	Specification for Design of Cold- Formed Steel Structural Members - with 1989 Addendum	2206.1, 2206.3 2206.3.1
CFSD-LRFD-91	Load and Resistance Factor Design Specification for Cold-Formed Steel Structural Members	2206.1, 2206.3, 2206.3.1

AITC

American Institute of Timber Construction
Suite 407
1818 S. E. Mill Plain Blvd.
Vancouver, Washington 98684

Standard reference number	Title	Referenced in 780 CMR Section number
108-93	Standard for Heavy Timber Construction	2304.1
109-90	Standard for Preservative treatment of Structural Glued Laminated Timber	2313.1.1
112-93	Standard for Tongue and Groove Heavy Timber Roof Decking	2304.1
117-93	Standard Specifications for Structural Glued Laminated Timber of Softwood Species (Design)	2304.1
119-96	Standard Specifications for Hardwood Glued Laminated Timber	2304.1
A190.1-92	Structural Glued Laminated Timber	2304.1

ANSI

American National Standards Institute
11 West 42nd Street
New York, New York 10036

Standard reference number	Title	Referenced in 780 CMR Section number
A108.1-92	Specifications for the installation of Ceramic Tile with Portland Cement Mortar	2105.10, 3607.2.4
A108.4-92	Installation of Ceramic Tile with Organic Adhesives or Water Cleanable Tile Setting Epoxy Adhesive	2105.10.7, 3607.2.4
A108.5-92	Installation of Ceramic Tile with Dry-Set Portland Cement Mortar or Latex-Portland Cement Mortar	2105.10.1, 2105.10.3, 3607.2.4
A108.6-92	Installation of Ceramic Tile with Chemical Resistant, Water Cleanable Tile Setting and Grouting Epoxy	2105.10.4 3607.2.4
A108.7-92	Specifications for Electrically Conductive Ceramic Tile Installed with Conductive Dry-Set Portland Cement Mortar	2105.10.2,
A117.1		426.14
A108.8-92	Installation of Ceramic Tile with Chemical Resistant Furan Mortar and Grout	2105.10.5
A108.9-92	Installation of Ceramic Tile with Modified Epoxy Emulsion Mortar/Grout	2105.10.6
A108.10-92	Installation of Grout in Tilework	2105.10.8
A108.11-90	Installation of Interior Cementitious Backer Units	3607.2.4
A118.1-92	Specifications for Dry-Set Portland Cement Mortar	2105.10.1, 3607.2.4
A118.2-92	Specifications for Conductive Dry-Set Portland Cement Mortar	2105.10.2
A118.3-92	Specifications for Chemical Resistant Water Cleanable Tile Setting and Grouting Epoxy and Water Cleanable Tile Setting Epoxy Adhesive	2105.10.4, 3607.2.4
A118.4-92	Specifications for Latex-Portland Cement Mortar	2105.10.3
A118.5-92	Specifications for Chemical Resistant Furan	2105.10.5
A118.6-92	Specifications for Ceramic Tile Grouts	2105.10.8
A118.8-92	Specifications for Modified Epoxy Emulsion Mortar/Grout	2105.10.6
A136.1-92	Specification for Organic Adhesives for Installation of Ceramic Tile, Types I and II	2105.10.7, 3607.2.4
A137.1-88	Specifications for Ceramic Tile	2105.4, 3607.2.4

Standard reference number	Title	Referenced in 780 CMR Section number
A208.1-93	Wood Particleboard	2308.1, 2308.2, 3605.3.3.1, 3606.11.1, 3608.3.3.1
Z97.1-84	Safety Performance Specifications and Methods of Test for Safety Glazing Materials Used in Buildings	2406.1, 3603.20.1, 3603.20.4.1.1
Z21.66-85	Electrically Operated Automatic Vent Damper Devices for Use with Gas-fired Appliances	3621.2.2.2
NWWDA I.S.2-87	Industry Standard for Wood Window Units	3606.8.1
NWWDA I.S.3-88	Industry Standard for Wood Sliding Doors	3606.9.1

APA

American Plywood Association
P.O. Box 11700
Tacoma, WA 98411

Standard reference number	Title	Referenced in 780 CMR Section number
E30-90	Design and Construction Guide: Residential and Commercial	3608.3.2.3

ASCE

American Society of Civil Engineers
345 East 47th Street
New York, NY 10017

Standard reference number	Title	Referenced in 780 CMR Section number
ASCE 3-84	Specifications for the Design and Construction of Composite Slabs	2206.1.1
ASCE 5/ACI 530/TMS 402-95	Building Code Requirements for Masonry Structures	707.3, 1705.7, Table 1705.7, 1812.3.2 Table 1812.3.2, 2101.1.1, 2104.2, 2104.3, 2104.4, 2106.3.1
ASCE 6/ACI 530.1/TMS 602-95	Specifications for Masonry Structures	2112.1.1
ASCE 7-95	Minimum Design Loads for Buildings and Other Structures	1604.2, 1605.1, 1611.12, 1611.12.2
ASCE 8-SSD-LRFD/ASD-90	Specifications for Design of Cold-Formed Stainless Steel Structural Members	2206.1, 2206.3, 2206.3.1

ASHRAE

American Society of Heating,
Refrigerating and Air Conditioning Engineers
1791 Tullie Circle, N.E.
Atlanta, Georgia 30329-2305

Standard reference number	Title	Referenced in 780 CMR Section number
90.1-1989	Energy Code for Commercial and High Rise Residential Buildings	1314.5.2

ASME

American Society of Mechanical Engineers
345 East 47th Street
New York, New York 10017

Standard reference number	Title	Referenced in 780 CMR Section number
A13.1-81(85)	Scheme for Identification of Piping Systems	416.15.3
B31.3-93	Chemical Plant and Petroleum Refinery Piping	416.15

ASTM

American Society for Testing Materials
1916 Race Street
Philadelphia, Pennsylvania 19103

Standard reference number	Title	Referenced in 780 CMR Section number
A6-95c	Specification for General Requirements for Rolled Steel Plates, Shapes, Sheet Piling, and Bars for Structural Use	Table 1705.5.2
A36-94	Specification for Structural Steel	1818.1, 2105.9.5, 3606.4.14
A82-95	Specification for Steel Wire, Plain, for Concrete Reinforcement	2105.9.2, 2105.9.5, 3606.4.14
A153-95	Specification for Zinc Coating (Hot Dip) on Iron and Steel Hardware	2105.9.6, Table 3606.4.14.1
A167-94a	Specification for Stainless and Heat-Resisting Chromium-Nickel steel Plate, Sheet, and Strip	2105.9.2, 2105.9.5, 2105.9.6, 3604..14, Table 3606.4.14.1
A185-94	Specification for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement	2105.9.4, 2105.9.5
	(Note: ASTM A256 - 82 has been discontinued and not replaced by ASTM)	
A252-93	Specification for Welded and Seamless Steel Pipe Piles	1818.1, 1819.1
A283-93a	Specification for Low and Intermediate Tensile Strength Carbon Steel Plates	1818.1, 1819.1
A361-94	Specification for Steel Sheet, Zinc-Coated (Galvanized) by Hot-Dip Process for Roofing and Siding	1507.3.7, 3609.5.2
A366-91	Specification for Steel, Sheet, Carbon, Cold-Rolled Commercial Quality	2105.9.5
A416-94a	Specification for Steel Strand, Uncoated Seven Wire for Prestressed Concrete	1821.3.2
A496-95	Specification for Steel Wire, Deformed, for Concrete Reinforcement	2105.9.3
A 497-95	Specification for Steel Welded Wire Fabric, Deformed, for Concrete Reinforcement	2105.9.4
A510-82	Specification for Wire Rods and Course Round Wire, Carbon Steel	3606.4.14
A 525-91b	Specification for General Requirements for Steel Sheet, Zinc - Coated (Galvanized) by the Hot - Dip Process	2105.9.6, Table 3606.4.14.1, 3619.1.1.1.3
A 568-95	Specification for Steel Sheet, Carbon and High - Strength, Low - Alloy, Hot - Rolled and Cold - Rolled, General Requirements for	Table 1705.5.2
A 572 -94c	Specification for High - Strength Low Alloy Columbium - Vanadium Steels of Structural Quality	1818.1
A 588 -94	Specification for High - Strength Low Alloy Structural Steel with 50 ksi (345 Mpa) Minimum Yield Point to 4 in. (100 mm) Thick	1818.1
A 615 -95c	Specification for Deformed and Plain Billet - Steel Bars for Concrete Reinforcement	2105.9.1
A 616 -95b	Specification for Rail - Steel Deformed and Plain Bars for Concrete Reinforcement	2105.9.1
A 617 -95b	Specification for Axle - Steel Deformed and Plain Bars for Concrete Reinforcement	2105.9.1
A 641 -92	Specification for Zinc-Coated (Galvanized) Carbon Steel Wire	2105.9.6, Table 3606.4.14.1
A 706 -95b	Specification for Low - Alloy Steel Deformed Bars for Concrete Reinforcement.	1705.6.1, 1906.5.2, 2105.9.1
A 755 -95	Specification for Steel Sheet, Metallic - Coated by the Hot - Dip Process and Prepainted by the Coil - Coating Process for Exterior Exposed Building Products	1507.3.7
B101-92	Specification for Lead - Coated Copper Sheets	1507.3.7

Standard reference number	Title	Referenced in 780 CMR Section number
B 209-89	Specification for Aluminum and Aluminum-Alloy Sheet and Plate	3609.5.2
B 227-80	Specifiation for Hard-Drawn Copper-Clad Steel Wire	3606.4.14
C 5 -79	Specification for Quicklime for Structural Purposes (Re-approved 1992)	Table 2505.2, 3607.2.2
C 28-92	Specifications for Gypsum Plasters	Table 2505.2, 3607.2.2
C 31-95	Practice for Making and Curing Concrete Test Specimens in the Field	1908.3.2, 1908.3.3
C 33-93	Specifications for Concrete Aggregates	1906.3, Table 1907.1.1
C 34-93	Specifications for Structural Clay Load-Bearing Wall Tile	2105.2,
C 35-95	Specifications for Inorganic Aggregates for Use in Gypsum Plaster	Table 2505.2, 3607.2.2
C 36-92	Specifications for Gypsum Wallboard	Table 2503.2, 3607.2.3.1
C 37-92	Specifications for Gypsum Lath	Table 2505.2, 3607.2.2
C 39-94	Test Method for Compressive Strength of Cylindrical Concrete Specimens	1908.3.2
C 55-95	Specification for Concrete Building Brick	2105.1
C 56-93	Specification for Structural Clay Non-Load-Bearing Tile	2105.2
C 59-91	Specifications for Gypsum Casting and Molding Plaster	Table 2505.2, 3607.2.2
C 61-95	Specifications for Gypsum Keene's Cement	Table 2505.2, 3607.2.2
C 62-95a	Specifications for Building Brick (Solid Masonry Units made from from Clay or Shale)	2105.2, 3602.2
C 67-94	Test Methods of Sampling and Testing Brick and Structural Clay Tile	2112.5
C 73-95	Specifications for Calcium Silicate Face Brick (Sand Lime Brick)	2105.1
C 79-95	Specifications for Gypsum Sheathing Board	Table 2503.2, Table 3606.2.3(a)
C 90-85	Hollow Load-Bearing Concrete Masonry Units	3602.2
C 94-95	Specifications for Ready-Mix Concrete	1908.5.1
C 126-95	Specifications for Ceramic Glazed Structural Clay Facing Tile, Facing Brick and Solid Masonry Units	2105.2
C129-85	Nonload-Bearing Concrete Masonry Units	3602.2
C145-85	Solid Load-Bearing Concrete Masonry Unit	3602.2
C150-95	Specification for Portland Cement	1906.2, 1907.1.2.1, 1907.1.2.2.3, 1908.2.1, 1908.2.2, Table 2505.2, 3604.2.2
C 172-90	Practice for Sampling Freshly Mixed Concrete	1908.3.2
C 206-84	Specification for Finishing Hydrated Lime	Table 2505.2
C 208-95	Specification for Cellulosic Fiber Insulating Board	2309.1, Table 3606.2.3(a)
C 212-93	Specification for Structural Clay Facing Tile	2105.2
C 216-95a	Specification for Facing Brick (Solid Masonry Units Made from Clay or Shale).	2105.2
C 222-91	Specifications for Asbestos-Cement Roofing Shingles	1507.2.1
C 231-91b	Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.	1907.1.1
C 260-95	Specification for Air-Entraining Admixtures for Concrete	1906.6.2
C 270-95	Specification for Mortar for Unit	2105.7, 3606.7.1.1
C 330-89	Specification for Lightweight Aggregates for Structural Concrete	1906.3
C 406-89	Specification for Roofing Slate	1507.2.7, 3609.4.2
C 474-94	Test Methods for Joint Treatment Materials for Gypsum Board Construction	Table 2503.2
C 475-94	Specification for Joint Compound and Joint Tape for Finishing Gypsum Board.	Table 2503.2, 3607.2.3.1
C476-95	Specification for Grout for Masonry	2105.11, 3606.7.1.1
C494-92	Specification for Chemical Admixtures for Concrete	1906.6.2
C503-89	Specification for Marble Dimension Stone (Exterior)	2105.3
C514-94	Specification for Nails for the Application of Gypsum Wallboard	Table 2503.2, 3607.2.3.1
C532-88	Specification for Structural Insulating Formboard (Cellulosic Fiber)	2309.1
C 557-93	Specification for Adhesives for Fastening Gypsum Wallboard to Wood Framing.	3607.2.3.1
C 568-89	Specification for Limestone Dimension Stone	2105.3
C 578-87	Specification for Preformed Cellular Polytyrene Thermal Insulation	3604.3.3
C 587-91	Specification for Gypsum Veneer Plaster	Table 2505.2, 3607.2.2
C 588-95	Specification for Gypsum Base for Veneer Plasters	Table 2505.2, 3607.2.2
C 595-95a	Specification for Blended Hydraulic Cements	1907.1.2.1, 1907.1.2.2.1, 1907.1.2.2.2, 1908.2.2, 3604.2.2

Standard reference number	Title	Referenced in 780 CMR Section number
C 615-92	Specification for Granite Dimension Stone	2105.3
C 616-95	Specification Quartz- Based Dimension Stone	2105.3
C 618-95	Specification for Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete	1906.6.3, 1907.1.2.1, 1907.2.2.1
C 629-89	Specification for Slate Dimension Stone	2105.3
C 630-95	Specification for Water - Resistant Gypsum Backing Board	Table 2503.2, 2503.4 3607.2.4.1
C 631-95a	Specification for Bonding Compounds for Interior Plastering	Table 2505.2, 3607.2.2
C 645-95a	Specification for Non-Load (Axis) Bearing Steel Studs, Runners (Track), and Rigid Furring Channels for Screw Application of Gypsum Board	Table 2503.2, Table 2505.2, 3607.2.3.3
C 652-95c	Specification for Hollow Brick (Hollow Masonry Units Made from Clay or Shale)	2105.2
C 685-95	Specification for Concrete Made by Volumetric Batching and Continuous Mixing	1908.5.1
C 744-95a	Specification for Prefaced Concrete and Calcium Silicate Masonry Units	2105.1
C 754-95a	Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Board	Table 2504.1
C 836-89a	Specification for High- Solids Content, Cold Liquid- Applied Elastometric Waterproofing Membrane for Use With Separate Wearing Course	1507.3.6
C 841-90	Specification for Installation of Interior Lathing and Furring	Table 2504.1
C 842-85	Specification for Application of Interior Gypsum Plaster	Table 2504.1
C 843-94	Specification for Application of Gypsum Veneer Plaster	Table 2504.1, 3607.2.2
C844-85	Specification for Application of Gypsum Base to Receive Gypsum Veneer Plaster	Table 2504.1, 3607.2.2
C847-93	Specification for Metal Lath (Re-approved 1992)	Table 2505.2, 3607.2.2
C887-95	Specification for Packaged, Dry, Combined Materials for Surface Bonding Mortar	1813.3.2.2, 2105.8, 3604.6.1
C897-95a	Specification for Aggregate for Job-Mixed Portland Cement-Based Plasters	Table 2505.2, 3607.2.2
C926-95	Specification for Application of Portland Cement Based-Plaster	2506.3
C932-85	Specification for Surface-Applied Bonding Agents for Exterior Plastering	Table 2505.2
C933-85	Specification for Welded Wire Lath (Re-approved 1990)	Table 2505.2, 3607.2.2
C946-91	Practice for Construction of Dry-stacked, Surface-Bonded Walls	2105.8, 2106.4
C954-93	Specification for Steel Drill Screws for the Application of Gypsum Board or Metal Plaster Bases to Steel Studs from 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness	Table 2503.2, Table 2505.2, 3607.2.3.5
C955-95b	Specification for Load Bearing (Transverse and Axial) Steel Studs, Runners (Track), and Bracing or Bridging for Screw Application of Gypsum and Metal Plaster Bases	Table 2505.2, 3607.2.3.3
C957-93	Specification for High- Solids Content, Cold Liquid- Applied Elastometric Waterproofing Membrane with Integral Wearing Surface	1507.3.6
C960-91	Specifications for Predecorated Gypsum Board	3607.2.3.1
C989-95	Specification for Ground Granulated Blast - Furnace Slag for Use in Concrete and Mortars	1906.6.4, 1907.1.2.1, 1907.1.2.2.2,
C1002-93	Specification for Drill Screws for the Application of Gypsum Board or Metal Plaster Bases	Table 2503.2, Table 2505.2, 3607.2.3.1, 3607.2.3.5
C1007-83	Specification for Installation of Load Bearing (Transverse and Axial) Steel Studs Accessories and Related Accessories	Table 2504.1
C1029-90	Specification for Spray - Applied Rigid Cellular Polyurethane Thermal Insulation	1507.3.5
C1032-86	Specification for Woven Wire Plaster Base (Re-approved 1990)	3607.2.2
C1047-85	Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base (Re-approved 1990)	3607.2.2, 3607.2.3.1
C1063- 95a	Specification for Installation of Lathing and Furring for Portland Cement - Based Plaster	2506.3, 3607.2.2

Standard reference number	Title	Referenced in 780 CMR Section number
C1088-94	Specification for Thin Veneer Brick Units Made from Clay or Shale	2105.2
D1586		
D25-91	Specification for Round Timber Piles	1822.1
D56-93	Test Method for Flash Point by Tag Closed Tester	307.2
D86	Test Method for Distillation of Petroleum Products	307.2
D93-94	Test Methods for Flash Point by Pensky-Martens Closed Tester	307.2
D224-89	Specification for Smooth- Surfaced Asphalt Roll Roofing (Organic Felt)	1507.2.2
D225-95	Specification for Asphalt Shingles (Organic Felt) Surfaced With Mineral Granules	1507.2.3
D226-95	Specification for Asphalt- Saturated Organic Felt Used in Roofing and Waterproofing	Table 1507.3.1
D227-95	Specification for Coal-Tar Saturated Organic Felt Used in Roofing and Waterproofing	Table 1507.3.1
D249-89	Specification for Asphalt Roll Roofing (Organic Felt) Surfaced with Mineral Granules	1507.2.2
D312-95	Specification for Asphalt Used in Roofing	Table 1507.3.1, 3609.7.4.2
D323-94	Test Method for Vapor Pressure of Petroleum Products (Reid Method)	307.2
D368	Tension Load Test	
D371-89	Specification for Asphalt Roll Roofing (Organic Felt) Surfaced with Mineral Granules; Wide- Selvage	1507.2.2
D450-91	Specification for Coal-Tar Pitch Used in Roofing, Dampproofing, and Waterproofing	Table 1507.3.1
	(Note 568-77 has been discontinued and not replaced by ASTM)	
D635-91	Test Method for Rate of Burning and/or Extent and Time of Burning of Self-Supporting Plastics in a Horizontal Position	2601.2, 2604.1
D1143-81	Test Method for Piles under Static Axial Compressive Load	1817.4.2, 1817.4.3
D1227-87	Specification for Emulsified Asphalt Used as a Protective Coating for Roofing	1507.3.6
D1248-84 (1989)	Specification for Polystyrene Plastics Molding and Extrusion Materials	3619.1.1.2
D1557	Test methods for Moisture-Density Relations of Soils and Soil Aggregate Mixtures Using 10-lb. (4.54-kg) Rammer and 18-in. (457-mm) Drop	1804.3.2, 1805.3
D 1586-84	Method for Penetration Test and Split Barrel Sampling of Soils	Table 1804.3, App. D
D1761-88	Test Methods for Mechanical Fasteners in Wood	2312.1, 2312.2, 2312.3
D1784-90	Specification for Rigid Poly (Vinyl Chloride) (PFC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds	3619.1.1.2
D1863- 86	Specification for Mineral Aggregate Used on Built-Up Roofs	Table 1507.3.1
D 1929-93	Test Method for Ignition Properties of Plastics	2601.2, 2604.2
D2178-89	Specification for Asphalt Glass Felt Used in Roofing and Waterproofing	Table 1507.3.1
D2412-87	Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading	3619.1.1.2
D2487	Classification of Soils for Engineering Purposes (Unified Soil Classification System)	Appendix D
D2488	Practice for description and Identification of Soils (Visual-Manual Procedure)	Appendix D
D2626-95	Specification for Asphalt-Saturated and Coated Organic Felt Base Sheet Used in Roofing	Table 1507.3.1
	(Note: D2277-87 has been discontinued and not replaced by ASTM)	
D2843-93	Test Method for Density of Smoke from the Burning or Decomposition of Plastics	2601.2, 2604.1
D2898-94	Methods for Accelerated Weathering of Fire-Retardant Tested Wood for Fire Testing	1506.2, 2310.3
D2938		Table 1804.3, App. D
D3161-81	Test Method for Wind Resistance of Asphalt Shingles	1505.2.3
D3201-94	Test Method for Hygroscopic Properties of Fire-Retardant Wood and Wood-based Products	2310.3
D3462-93a	Specification for Asphalt Shingles Made from Glass Felt and Surfaced with Mineral Granules	1507.2.3
D3468-90	Specification for Liquid- Applied Neoprene and Chlorosulfonated Polyethylene Used in Roofing and Waterproofing	1507.3.6
D3672-86	Specification for Venting Asphalt - Saturated and Coated Inorganic Felt Base Sheet Used in Roofing	Table 1507.3.1
D3679-88	Rigid Poly (Vinyl Chloride) (PVC) Siding	Table 3607.3.4
D3689-90	Test Method Individual Piles under Static Axial Tensile Load	1817.7.2
D3746-85	Test Method for Impact Resistance of Bituminous Roofing Systems	1505.3.2

Standard reference number	Title	Referenced in 780 CMR Section number
D3909-95a	Specification for Asphalt Roll Roofing (Glass Felt) Surfaced with Mineral Granules	1507.2.2, Table 1507.3.1
D3966-90	Test Method for Piles Under Lateral Loads	1817.6.2
D4099-89	Specification for Poly (Vinyl Chloride) (PVC) Prime Wndows	3606.8.1
D4272-90a	Test Method for Total Energy Impact of Plastic Films by Dart Drop	1505.3.2
D4434-87	Specification for Poly (Vinyl Chloride) Sheet Roofing	1507.3.3
D4601-95	Specification for Asphalt Coated Glass Fiber Base Sheet Used in Roofing	Table 1507.3.1
D4637-87	Specification for Vulcanized Rubber Sheet Used in Single-Ply Roof Membrane	1507.3.2
D5055-95a	Specification for Establishing and Monitoring Structural Capacities of Prefabricated Wood I-Joists	2313.5
E72-95	Methods of Conducting Strength Tests of Panels for Building Construction	2305.7
E84-95b	Test Method for Surface Burning Characteristics of Building Materials	412.3.6.3, 428.11, 704.4.1.2, 722.2, 722.3, 803.2, 803.3.2, 2310.2, 2601.2, 2603.3, 2603.6.3, 2603.7.4, 2604.1, 2805.2.2, 3105.3, 3603.17.1.1, 3603.17.2.6, 3603.17.3, 3603.18.3, 3603.19.1, 3603.19.2, 3612.2
E90-90	Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions	1214.2, 3603.4.3.1
E96-90	Standard Test for Water Vapor Transmission of Materials	
E108-95	Test Methods for Fire Tests of Roof Coverings	1506.1, 1506.2, 2608.2, 2608.3
E119-95a	Test Methods for Fire Tests of Building Construction and Materials	412.3.6.2, 704.1.1, 705.2.4 705.4, 707.7.2, 707.7.3, 707.8.1.2, 709.6.1, 709.6.2, 709.6.4, 709.7.1.2, 713.4.2, 2105.2, 2603.4, 3603.4.1
E136-95	Test Method for Behavior of Materials in Vertical Tube Furnace at 750°C	704.4.1.1, 3612.2
E152-81a	Methods of Fire Tests of Door Assemblies	716.1, 716.1.1, 3603.17.3
E163-84	Methods of Fire Tests of Window Assemblies	718.1, 719.1
E283-91	Test Method for Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified PressureDifferences Across the Specimen	3606.8.2, 3606.9.2
E492-90	Test Method for Laboratory Measurement of Impact Sound Transmission Through Floor-Ceiling Assemblies Using the Tapping Machine	1214.3, 3603.4.3.3
E648-95	Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source	805.2
E814-94b	Test Method for Fire Tests of Through-Penetration Fire Stops	707.7.2, 707.7.3, 709.6.1, 709.6.2, 713.4.1
E838-81	Practice for Performing Accelerated Outdoor Weathering Using Concentrated Natural Sunlight	1505.3.1
E970-89	Test Method for Critical Rdiant Flux of Exposed Attic Floor Insulation Using a Radiant Heat Energy Sources	3603.19.4
E1509-	Specification for Room Heaters, Pellet Fuel-Burning Type	
G23-95	Practice for Operating Light- Exposure Apparatus (Carbon- Arc Type) With and Without Water for Exposure of Nonmetallic Materials	1505.3.1
G26-95	Practice for Operating Light- Exposure Apparatus (Xenon- Arc Type) With and Without Water for Exposure of Nonmetallic Materials	1505.3.1
G53-95	Practice for Operating Light- and Water- Exposure Apparatus (Fluorescent UV - Condensation Type) for Exposure of Nonmetallic Materials	1505.3.1

AWPA **American Wood Preservers Association**
P.O. Box 5690
Granbury, TX 76049
(1-817-326-6300)

Standard reference number	Title	Referenced in 780 CMR Section number
C1-95	All Timber Products -Preservative Treatment by Pressure Processes	1506.3, 2311.3, 3603.22.3.1
C2-95	Lumber, Timber, Bridge Ties and Mine Ties -Preservative Treatment by Pressure Processes	1808.1, 1808.2, 2311.3, 2311.4, 2311.5, 2311.7, 3603.22.3.1, 3603.22.4
C3-97	Piles - Preservative Treatment by Pressure Processes	1808.1, 1822.2, 3603.22.3.1
C4-95	Poles - Preservative Treatment by Pressure Processes	3603.22.3.1
C9-95	Plywood- Preservative Treatment by Pressure Processes	2311.3, 2311.4, 2311.5, 2311.7, 3603.22.3.1, 3603.22.4
C15-90	Wood for Commercial-Residential Constrruction Preservative Treatment by Pressure Process	3603.22.3.1
C18-90	Standard for Pressure-treated Material in Marine Construction	3603.22.3.1
C20-93	Structural Lumber - Fire- Retardant Treatment Pressure Processes	2310.2, 3603.22.3.1
C22-93	Lumber and Plywood for Permanent Wood Foundations - Preservative Treatment by Pressure Processes	1808.3, 3603.22.3.1, 3604.2.1.2, 3605.4.3
C23-84	Round Poles and Posts Used in Building Construction, Preservative Treatment by Pressure Process	3603.22.3.1
C24-86	Sawn Timber Piles Used for Residential Commerce Building	3603.22.3.1
C27-93	Plywood- Fire-Retardant Treatment by Pressure Process	2310.2, 3603.22.3.1
C28-90	Standard for Preservative Treatment of Structural Glues-Laminated Members and Laminations Before Cluing of Southern Pine, Pacific Coast Douglas Fir, Hem-fir and Western Hemlock by Pressure Process	
M4-95	Standard for the Care of Preservative- Treated Wood Products	1822.2
P1/P13-95	Standard for Coal Tar Creosote for Land and Fresh Water and Marine (Coastal Water) Use	2311.3, 3603.22.3.1
P2-95	Standard for Creosote Solutions	2311.3, 3603.22.3.1
P3-89	Standard for Creosote - Petroleum Oill Solution	3603.22.3.1
P5-95	Standards for Waterborne Preservatives	2311.3, 3603.22.3.1, 3604.2.1.2
P8-95	Standards for Oil- Borne Preservatives	2311.3, 3603.22.3.1
P9-92	Standards for Solvents and Formulations for Organic Preservative Systems	2311.3, 3603.22.3.1

AWS **American Welding Society**
550 N.W. Lejeune Road
P.O. Box 351040
Miami, Florida 33135

Standard reference number	Title	Referenced in 780 CMR Section number
D1.1-92	Structural Welding Code- Steel	1705.5.3.2.1
D1.4-92	Structural Welding Code- Reinforced Steel	1906.5.2

BOCA

Building Officials and Code Administrators International
4051 West Flossmoor Road
Country Club Hills, Illinois 60477-5795

Standard reference number	Title	Referenced in 780 CMR Section number
BNFOC-93	BOCA National Fire Prevention Code **Note**: 527 CMR is the Fire Prevention code for Massachusetts	
BNMC-93	BOCA National Mechanical Code	201.3, 307.8, 408.4.1, 408.5, 411.3, 416.9, 417.1, 417.3, 418.3.1.4, 418.3.2, 418.3.2.3, 418.3.3, 418.3.4, 419.2, 419.2.1, 602.4.2, 602.4.3, 717.2, 722.2, 913.1, 1203.1, 1208.3, 1209.1, 1210.3, 2114.2, 2114.9, 2305.12, 2801.2, 2802.1, 2802.3, 2804.1, 2805.2.3, 2805.2.4, 2808.3, 2811.1, 3107.6, 3309.2, 3603.6.7.1
BNPC-93	BOCA National Plumbing Code **Note**: 248 CMR is the Plumbing Code for Massachusetts	

CGSB

Canadian General Standards Board
Technical Information Unit
PC1, Phase III, Place Du Portage
Hull, Ottawa, Canada K1A 1G6

Standard reference number	Title	Referenced in 780 CMR Section number
37-GP-52M-84	Roofing and Waterproofing Membrane, Sheet Applied, Elastometric	1505.3.2, 1507.3.2
37-GP-54M-79	Roofing and Waterproofing Membrane, Sheet Applied, Flexible, Polyvinyl Chloride	1507.3.3
37GP-56M-80	Membrane, Modified, Bituminous, Prefabricated, and Reinforced for Roofing - with Dec. 1985 revision	1507.3.4

CPSC

Consumer Product Safety Commission
Office of the Secretary
Washington, D.C. 20207

Standard reference number	Title	Referenced in 780 CMR Section number
16CFR Part 1201-77	Safety Standard for Architectural Glazing	2405.1, 2406.1, 2407.2, 3603.20.4.1, 3603.20.4.1.1
16CFR Part 1209-86	Interim Safety Standard for Cellulose Insulation	722.4
16CFR Part 1404-86	Cellulose Insulation	722.4
16CFR Part 1500-84	Hazardous Substances and Articles; Administration and Enforcement Regulations	307.2
16CFR, Part 1630 (DOC FF-1)-70	Standard for the Surface Flammability of Carpets and Rugs	805.3, 805.5

CSA

Canadian Standards Association
178 Rex Dale Boulevard
Rex Dale, Ontario, Canada M9W1R3

Standard reference number	Title	Referenced in 780 CMR Section number
CSA 0437-M92	OSB and Waferboard	3605.3.2.1.2, 3608.3.2.1.3

CSSB

Cedar Shake and Shingle Bureau
515 116TH Avenue, NE, Suite 275
Bellevue, WA 98004

Standard reference number	Title	Referenced in 780 CMR Section number
CSSB-84	Grading and Packing Rules for Certigrade Red Cedar Shingles (Revised February 1, 1984)	3609.8.2
CSSB-85	Grading and Packing Rules for Cert-Split Red Cedar Shakes (Revised October 1, 1985)	3609.9.2
CSSB-90	Grading Rules for Shake Hip and Ridge based on the Standards of the Cedar Shake and Shingle Bureau	3609.8.3.3, 3609.9.3.4
CSSB-90	Grading Rules for Certi-Sawn Taper-Sawn Cedar Shakes (Revised May 30, 1990)	3609.9.2
CSSB-90	Wood Shakes (Preservative Treated) based on Grading and Packing Rules for Treated Southern Pine Taper-Sawn Shakes of the Cedar Shake and Shingle Bureau	3609.9.3
CSSB-93	Grading Rules for Wood Shakes and Shingles Exterior and Interior Walls - Design and Application Manual for, 1989 New Roof Coverings - Red Cedar Shingle and Shake Design and Application Manual for, 1989 Red Cedar Shingles - Grading Rules for Certi-Grade, 1984 Wood Shakes - Grading Rules for Certi-Sawn Taper Sawn Red Cedar Shakes, 1981 Grading Rules for Certi-Split Red Cedar Shakes, 1985 Wood Shingles - Grading Rules for Certi-Grade Shingles, 1984	3607.2.6, 3607.3.5

CWC

Canadian Wood Council
1730 St. Laurent Boulevard - Suite 350
Ottawa, Ontario, Canada K1G 5L1

Standard reference number	Title	Referenced in 780 CMR Section number
CWC-87	Canadian Dimension Lumber Data Book	3608.2.2

DOC

United States Department of Commerce
National Institute of Standards and Technology
Gaithersburg, MD 20899

Standard reference number	Title	Referenced in 780 CMR Section number
PS 1-95	Construction and Industrial Plywood	2306.4.6, 2307.1, 3606.10.1, 3608.3.2.1, Table 3604.4.3.3
PS 2-95	Performance Standard for Wood- Based Structural- Use Panels	2307.1, 3604.4.3.3, 3605.3.2.1, 3605.3.2.1.2, 3606.10.1 3608.3.2.1
PS 20-94	American Softwood Lumber Standard -with 1991 Amendments	2302.1, 3604.4.3.1, 3605.2.1, 3606.2.1, 3608.2.1
FF-1(CPSC 16 CFR, Part 1630) -70	Standard for the Surface Flammability of Carpet and Rugs	805.3, 805.5

DOTn

U.S. Department of Transportation
c/o Superintendent of Documents
U.S. Government Printing Office
Washington, D.C. 20402-9325

Standard reference number	Title	Referenced in 780 CMR Section number
49 CFR, Part 100-178 & 179-199 -88	Specification for Transportation of Explosive and Other Dangerous Articles, Shipping Containers	307.2

EIA **Electronics Industries Association**
2001 Pennsylvania Avenue, NW
Washington, D.C. 20006

Standard reference number	Title	Referenced in 780 CMR Section number
222-E - 91	Structural Standards for Steel Antenna Towers and Antenna Supporting Structures	3108.4

FM **Factory Mutual Engineering Corporation**
Standards Laboratories Department
1151 Boston Providence Turnpike
Norwood, Massachusetts 02062

Standard reference number	Title	Referenced in 780 CMR Section number
4450-90	Approval Standard for Class I Insulated Steel Deck Roofs -with Supplement (July 1992)	1505.2.2, 2603.4.1.5
4470-86	Approval Standard for Class 1 Roof Coverings -with Supplement 3 (August 1992)	1505.2.2, 1505.3.2
4880-94	Test Procedure for Building Corner Fire Test	2603.8, 3603.17.3

GA **Gypsum Association**
103 Orrington Avenue, Suite 1210
Evanston, IL 60201

Standard reference number	Title	Referenced in 780 CMR Section number
GA 253-93	Recommended Specification for the Application of Gypsum Seathing	Table 3606.2.3(a)

HPMA **Hardwood Plywood Manufactures Association**
1825 Michael Faraday Drive, P.O. Box 2789
Reston, Virginia 22090-2789

Standard reference number	Title	Referenced in 780 CMR Section number
HP-83	Hardwood and Decorative Plywood	2307.1, 3607.2.5
HP-SG-86	Structural Design Guide for Hardwood Plywood Wall Panels	2307.1, 3605.3.2.1, 3606.10.1

MASSACHUSETTS, COMMONWEALTH OF
CODE OF MASSACHUSETTS REGULATIONS (CMR)

Specific numbers have been established by the Massachusetts Office of the Secretary of State to identify for reference purposes all rules and regulations promulgated by agencies of the Commonwealth of Massachusetts. These numbers are designated as "Code of Massachusetts Regulations" (CMR's). Although they may not be cited in the text of 780 CMR, the CMR's listed below are pertinent to building construction and design or maintenance.

Board of State Examiners of Plumbers and Gas Fitters
100 Cambridge Street
Boston, MA 02202

CMR number	Title	780 CMR Section number
248 CMR 2.00	Massachusetts State Plumbing Code	201.3, 408.4, 418.3.4, 421.7, 602.4.3, 1212.7, 1813.5.3
248 CMR 4.00 - 7.00	Massachusetts Fuel Gas Code	
	Department of Mental Health **25 Staniford Street** **Boston, MA 02114**	
104 CMR 17.13		429.1, 429.1.6
	Department of Mental Retardation **160 North Washington Street** **Boston, MA 02114**	
115 CMR 7.00 - 8.00		423.1.1, 427.1.1.1
	Outdoor AdvertisingBoard **100 Cambridge Street, Floor 20** **Boston, MA 02002**	
711 CMR 3.00	Control and Restriction of Billboards, Signs and Other Advertising Devices	
	Department og Emvironmental Protection **One Winter Street** **Boston, MA 02208**	
310 CMR		401.2
	Department of Public Health **150 Tremont** **Boston, MA 02111**	
105 CMR 130.000	Hospital Licensure	
105 CMR 140.000	Licensure of Clinics	
	Designer's Guide (Bureau of Planning and Construction) Dispensaries and Clinics, December 21, 1966-	
105 CMR 151.000	General Standards of Construction for Long Term Care Facilities in Massachusetts	
105 CMR	Intensive Care Unit Amendment, October 1, 1972	
105 CMR 400.000	State Sanitary Code Chapter I: General Administrative Procedures	
105 CMR 410.000	Minimum Standards of Fitness for Human Habitation (State Sanitary Code: Chapter II):	
105 CMR 420.000	Housing and Sanitation Standards for Farm Labor Camps (State Sanitary Code: Chapter III)	
105 CMR 430.000	Minimum Sanitation and Safety Standards for Recreational Camps for Children (State Sanitary Code: Chapter IV)	
105 CMR 435.000	Minimum Standards for Swimming Pools (State Sanitary Code: Chapter V)	421.7
105 CMR 440.000	Minimum Standards for Developed Family Type Campgrounds (State Sanitary Code: Chapter VI)	
105 CMR 590:000	State Sanitary Code Chapter X - Minimum Sanitation Standards for Food Establishments	
	Division of Industrial Safety **100 Cambridge Street, 11th Floor** **Boston, MA 02202**	
454 CMR 2.00	Toilets in Industrial Establishments *Industrial Bulletin No. 4*	
454 CMR 10.00	Construction Industry Rules and Regulations *Industrial Bulletin No. 12*	
454 CMR 11.00	Structural Painting Safety Code *Industrial Bulletin No. 13*	
454 CMR 12.00	Requirements for the Care of Employees Injured or Taken Ill in Industrial Establishments *Industrial Bulletin No. 14*	
454 CMR 16.00	Lighting Code for Factories, Workshops, Manufacturing, Mechanical and Mercantile Establishments *Industrial Bulletin No. 18*	
454 CMR 19.00	Window Cleaning *Industrial Bulletin No. 21*	

Architectural Access Board
Department of Public Safety
One Ashburton Place, 13 th Floor
Boston, MA 02108

Standard reference number	Title	Referenced in 780 CMR Section number
521 CMR 1.00 - 47.00	Architectural Access Board Regulations	401.2, 421.5.5, 424.4.10
	Board of Boiler Rules **Department of Public Safety** **One Ashburton Place, Roon 1301** **Boston, MA 02108**	
522 CMR 2.00	Construction of Power Boilers	
522 CMR 3.00	Power Boilers, Power Reactor Vessels and Piping and Unfired Pressure Vessels as Used in Atomic Energy Installations	401.2
522 CMR 4.00	Steam and Hot Water Boilers and Heat Storage Sources	401.2
522 CMR 5.00	Heating Boilers	401.2
522 CMR 6.00	Low Pressure Heating Boilers	401.2
522 CMR 7.00	Air Tanks	401.2
522 CMR 8.00	Air Tanks	401.2
522 CMR 9.00	Refrigeration and Air Conditioning Systems	401.2
522 CMR 10.00	Material Specifications	401.2
522 CMR 11.00	Welding Specifications	401.2
522 CMR 12.00	Fiberglass-reinforced Plastic Pressure Vessels	401.2
	Board of Elevator Regulations **One Ashburton Place, Roon 1301** **Boston, MA 02108**	
524 CMR	The Massachusetts State Elevator Code	403.8
	Board of Fire Prevention and Regulation **1010 Commonwealth Avenue** **Boston, MA 02215**	
527 CMR :		
527 CMR 3.00	Dry Cleaning and Dry Dyeing and the Keeping, Storage and Use of Cleaning and Dyeing Fluids	401.2
527 CMR 4.00	Oil Burning Equipment	401.2
527 CMR 5.00	Operation and Maintenance of Buildings or Other Structures Used as Garages, Service Stations and the Related Storage, Keeping and Use of Gasoline or Other Motor Fuel	401.2, 408.6
527 CMR 6.00	Liquefied Petroleum Gas Containers and Systems	401.2, 418.3.3
527 CMR 7.00	Manufacture and Handling of Plastics	401.2
527 CMR 9.00	Tanks and Containers	401.2, 3103.1
527 CMR 10.00	Prevention of Fire in Buildings and in or on Ships	401.2, 426.15
527 CMR 12.00	1993 National Electrical Code (Amendments)	401.2, 403.9.1, 405.8, 405.9, 410.4.5, 414.5, 416.11, 416.14.6, 416.15.2, 417.5.4, 421.7, 426.14. 3102.6.3, 3102.13.1, 3107.7
527 CMR 14.00	Flammable and Combustible Liquids, Flammible Solids or Flammable Gases	401.2, 417.1, 417.2.1, 417.3, 417.5, 417.5.1, 417.5.2, 417.5.3, 417.6, 417.6.1, 417.6.3, 418.3.2, 418.1, 418.2, 418.2.1, 418.3, 418.3.1, 418.4, 418.5, 705.2.1
527 CMR 21.00	Decorations, Curtains, Draperies, Blinds and Other Window Treatments	401.2
527 CMR 49.03		426.5, 426.6, 429.1, 429.1.6

NCMA

National Concrete Masonry Association
2302 Horse Pen Road, P.O. Box 781
Herndon, VA 22070

Standard reference number	Title	Referenced in 780 CMR Section number
NCMA TR68-A-75	Design and Construction of Plain and Reinforced Concrete Masonry Basement and Foundation Walls	3604.4.1

NFPA

National Fire Protection Association
Batterymarch Park
Quincy, Massachusetts 02269

Standard reference number	Title	Referenced in 780 CMR Section number
10-94	Portable Fire Extinguishers	920.2
11-02	Low, Medium and High Expansion Foam	911.1, 911.5
11A-94	Medium and High Expansion Foam Systems	911.1, 911.5
12-93	Carbon Dioxide Extinguishing Systems	909.1, 909.5
12A-92	Halon 1301 Fire Extinguishing Systems	912.1, 912.5
12B-90	Halon 1211 Fire Extinguishing Systems	912.1, 912.5
13-02	Installation of Sprinkler Systems	412.7, 416.4, 426.3, 426.6, 706.2, 906.2.1, 906.9.1, 907.2.1, 917.7.3
231D now part of NFPA 13-02		
13D-02	Installation of Sprinkler Systems in One- and Two- Family Dwellings and Mobile Homes	423.6, 427.3.5, 906.2.3
13 R-02	Installation of Sprinkler Systems in Residential Occupancies Up to Four Stories in Height	426.7, 906.2.2, 923.1
14-03	Standpipe and Hose Systems	914.1, 914.3, 914.4, 914.5, 914.6
15-01	Water Spray Fixed Systems for Fire Protection	908.1, 908.4
16-03	Deluge Foam- Water Sprinkler and Spray Systems	911.1, 911.5
17-94	Dry Chemical Extinguishing System	910.1, 910.5
17A-94	Wet Chemical Extinguishing Systems	913.1, 913.5
20-03	Standard for the Installation of Sanitary Pumps for Fire Protection	924.1, 924.2, 924.3
22-02	Standard for Water Tanks for Private Fire Protection	
24-02	Installation of Private Fire Service Mains	417.6.3, 906.9.1, 914.6.1
25-02	Inspection, Testing, and Maintenance of Water-based Fire Protection Systems	901.4
30-00	Flammable and Combustible Liquids Code	307.8, 416.14, 418.3.2, 419.2.3, 426.3, 426.5, 426.11
30A-00	Automotive and Marine Service Station Code	408.6, 417.6.6
30B-94	Manufacture and Storage of Aerosol Products	426.3, 426.12
31-92	Oil Burning Equipment	3612.1
32-96	Dry Cleaning Plants	418.3.4
33-95	Spray Application Using Flammable and Combustible Materials	307.8, 419.1
34-95	Dipping and Coating Processes Using Flammable or Combustible Liquids	307.8, 419.1
40-94	Cellulose Nitrate Motion Picture Film	411.1
50-96	Bulk Oxygen Systems at Consumer Sites	2810.1
51-92	Oxygen-Fuel Gas Systems for Welding, Cutting and Allied Processes	2810.1
54-92	National Fuel Gas Code	3612.1.1
61-95	Prevention of Fire and Dust Explosions in Agricultural Food Products Facilities	418.3.1
65-93	Processing and Finishing of Aluminum	418.3.1
69-92	Explosion Prevention Systems	417.5.1.2
70-96	National Electrical Code (527 CMR 12.00: Massachusetts Amendments)	416.11, 416.14.6, 416.15.2, 602.4.4, 1405.4.3, 3102.6.3, 3102.13.1, 3107.7 *See also 527 CMR 12.00*
72-02	National Fire Alarm Code	403.6, 417.5.3, 426.14, 427.3.7, 427.3.8, 428.12.1, 428.16, 906.5, 917.1, 917.7.1.1, 917.6, 917.7, 917.7.3, 917.8.1, 917.9, 917.10, 918.1, 918.2.1, 918.8, 919.1, 919.6, 921.4, 923.1, 923.2, 923.2.1, 923.2.2, 923.2.3
80-95	Fire Doors and Windows	716.2, 716.5, 1017.4.4
80A-96	Protection of Buildings from Exterior Fire Exposures	

Standard reference number	Title	Referenced in 780 CMR Section number
82-94	Incinerators, Waste and Linen Handling Systems and Equipment	2807.1
90A-96	Installation of Air Conditioning and Ventilation Systems	
90B-96	Installation of Warm Air Heating and Air Conditioning Systems	
92A-96	Smoke Control Systems	
92B-95	Smoke Management System in Malls, Atria and Alrge Areas	
96-01	Ventilation Control and Fire Protection of Commercial Cooking Operations	
99-96	Health Care Facilities	2809.1, 2809.2
101-94	Life Safety Code	
102-95	Assembly Seating, Tents and Membrane Structures	3104.4
120-94	Coal Preparation Plants	418.3.1
130-95	Standard for Fixed Guideway Systems	
211	Chimney, Fireplace and Vents	3610.4
231-95	General Storage	426.3, 426.6
231C-95	Rack Storage of Materials	507.1, 426.3, Table 922.2
231D-94	Now also part of NFPA 13-02 Installation of Sprinkler Systems	
241-96	Safeguarding Construction, Alteration and Demolition Operations	903.1.5, 915.1, 914.7.2
259-87	Standard Test Method for Potential Heat of Building Materials	3603.17.2.5
409-01	Aircraft Hangers	426.3, 426.5, 426.6
416-93	Construction and Protection of Airport Terminal Buildings	
418-01	Roof-top Heliport Construction and Protection	1511.3
430-95	Storage of Liquid and Solid Oxidizers	426.3, 426.5, 426.6
495-96	Explosive Material Code	417.5.1 *See also 527 CMR*
502-96	Access Highways, Tunnels, Bridges, Air Right Structures	
651-93	Manufacture of Aluminum or Magnesium Powder	418.3.1
654-94	Prevention of Fire, and Dust Explosions in the Chemical, Dye, Pharmaceutical, and Plastics Industries	418.3.1
655-93	Prevention of Sulfur Fires and Explosions	418.3.1
664-93	Prevention of Fires and Explosions in Wood Processing and Woodworking Facilities	418.3.1
701-96	Standard Methods of Fire Tests for Flame Resistant Textiles and Films	807.2, 807.2.2, 3102.6.4.2, 3103.3.2, 3104.5, 3105.3
704-96	Identification of the Fire Hazards of Materials	416.2, 416.15.1
750-03	Installation of Water Mist Fire Protection Systems	
8503-96	Pulverized Fuel Systems	418.3.1

NFoPA
(AFPA)

American Forest and Paper Association*
1250 Connecticut Avenue, N.W./ Suite 200
Washington, D.C. 20036

Standard reference number	Title	Referenced in 780 CMR Section number
NDS-97	National Design Specification for Wood Construction -with 1997 Supplement; Design Values for Wood Construction	1801.1, 2303.1, 2304.1, 2305.14.1, 2305.15, 2306.4, 2306.4.5.1, 2306.4.5.2, 2306.4.6, 2306.4.6.1.1, 2306.4.6.2.1, 2306.4.7.1.1, 2306.4.7.2.1, 2312.1, 2312.4, 2313.3.1, 2313.3.2
TR7-87	Basic Requirements for Permanent Wood Foundation System	1808.3, 1813.3, 2311.3.3

**The National Forest Products Association (NFoPA) has changed their name to the American Forest and Paper Association (AFPA). The referenced standard in this code may be identified with the designation AFPA.*

RCSC

Research Council On Structural Connections
c/o American Institute of Steel Construction, Inc.
Suite 3100
One East Wacker Drive
Chicago, IL 60601-2001

Standard reference number	Title	Referenced in 780 CMR Section number
RCSC-85	Specifications for Structural Joints Using A325 or A490 Bolts	1705.5.3.2.1
RCSC-88	Specification for Load and Resistance Design	

RMA

Rubber Manufacturers Association
1200 K Street, N.W.
Washington, D.C. 20005

Standard reference number	Title	Referenced in 780 CMR Section number
RP-1-90	Minimum Requirements for Non- Reinforced Black EPDM Rubber Sheets	1507.3.2
RP-2-90	Minimum Requirements for Fabric- Reinforced Black EPDM Rubber Sheets	1507.3.2
RP-3-85	Minimum Requirements for Fabric- Reinforced Black Polychlorprene Rubber Sheets	1507.3.2

SJI

Steel Joist Institute
1205 48th Avenue North
Suite A
Myrtle Beach, South Carolina 29577

Standard reference number	Title	Referenced in 780 CMR Section number
SJI-94	Standard Specifications, Load Tables and Weight Tables for Steel Joists and Joist Girders	2205.1

SMACNA

Sheet Metal and Air Conditioning Contractors
National Association, Inc.
4201 Lafayette Center Drive
Chantilly, VA 22021

Standard reference number	Title	Referenced in 780 CMR Section number
SMACNA-88	Installation Standards for Residential Heating and Air Conditioning Systems	3619.1.3.1

TFS

Texas Forest Service
Forest Products Laboratory
P.O. Box 310
Lufkin, Texas 75902-0310

Standard reference number	Title	Referenced in 780 CMR Section number
TFS-90	Grading Rules for Preservative Treated Southern Yellow Pine Tapersawn Shakes	1507.2.9

#331

THE COMMONWEALTH OF MASSACHUSETTS

William Francis Galvin

Secretary of the Commonwealth

Regulation Filing *To be completed by filing agency*

CHAPTER NUMBER: 780 CMR R6

CHAPTER TITLE: Registration and Enforcement of Home Improvement Contractor Program

AGENCY: Department of Public Safety / Board of Building Regulations and Standards

SUMMARY OF REGULATION: *State the general requirements and purposes of this regulation.*

This Regulation allows for Home Improvement Contractor complaints and Construction Supervisor License complaints to be heard simultaneously if the Hearings Officer determines upon review of an HIC complaint that such complaint may involve CSL violations of 780 CMR R5. If the decision involves CSL matters, then such decision will comply with the requirements of 780 CMR R5.

REGULATORY AUTHORITY: c. 802 of the acts of 1972, as amended and MGL c.143 Sections 93-100

AGENCY CONTACT: Robert Anderson PHONE: 617-727-3200

ADDRESS: One Ashburton Plc, Rm 1301, Boston, MA 02108

Compliance with M.G.L. c. 30A

EMERGENCY ADOPTION - *If this regulation is adopted as an emergency, state the nature of the emergency.*

PRIOR NOTIFICATION AND/OR APPROVAL - *If prior notification to and/or approval of the Governor, Legislature or others was required, list each notification, and/or approval and date, including notice to the Local Government Advisory Commission.*

Local Government Notice on 4/21/04 and 10/18/04, respectively

PUBLIC REVIEW- *M.G.L. c. 30A. §§ 2 and/or 3 requires notice of the hearing or comment period be filed with the Secretary of the Commonwealth, published in appropriate newspapers, and set to persons to whom specific notice must be given at least 21 days prior to such hearing or comment period.*

Date of public hearing or comment period: Comment Period thru 6/11/04 and 12/9/04 respectively

FISCAL EFFECT - *Estimate the fiscal effect of the public and private sectors.*

For the first and second year: No estimate available but will improve administrative complaint process

For the first five years: No estimate available but will improve administrative complaint process

No fiscal effect: No estimate available but will improve administrative complaint process

SMALL BUSINESS IMPACT - *State the impact of this regulation on small business. Include a description of reporting, record keeping and other compliance requirements as well as the appropriateness of performance versus design standards and whether this regulation duplicates or conflicts with any other regulation. If the purpose of this regulation is to set rates for the state, this section does not apply.*

No estimate available but will improve administrative complaint process

CODE OF MASSACHUSETTS REGULATIONS INDEX - *List key subjects that are relevant to this regulation*:

780 CMR R6.3.1.1 - home improvement contractor license, non-compliance, hearings officer, 780 CMR R6.3.4.1.3.1 - construction supervisor license, 780 CMR R5 requirements

PROMULGATION - *State the action taken by this regulation and its effect on existing provisions of the Code of Massachusetts Regulations (CMR) to repeal, replace or amend. List by CMR number:*

Amends 780 CMR R6.3.1.1 and 780 CMR R6.3.4.1.3.1

ATTESTATION - *The regulation described herein and attached hereto is a true copy of the regulation adopted by this agency.* ATTEST:

SIGNATURE: DATE: 8/26/05

Publication - *To be completed by the Regulations Division*

MASSACHUSETTS REGISTER NUMBER: #1034 DATE: 9/9/05

EFFECTIVE DATE: 9/9/05

CODE OF MASSACHUSETTS REGULATIONS

Remove these pages:	*Insert these pages:*
795 - 798	795 - 798

A TRUE COPY ATTEST

William Francis Galvin

WILLIAM FRANCIS GALVIN
SECRETARY OF THE COMMONWEALTH

DATE 8/26/05 CLERK

TMS

The Masonry Council
Suite B
2619 Spruce Street
Boulder, CO 80302-3808

Standard reference number	Title	Referenced in 780 CMR Section number
TMS 402/ACI 530/ ASCE 5-95	Building Code Requirements for Masonry Structures	707.3, Table 1705.7, 1812.3.2, Table 1812.3.2, 2101.1.1, 2104.1, 2104.2, 2104.3, 2104.4.1, 2104.4.2, 2106.3.1
TMS 602/ACI 530.1/ASCE 6-95	Specifications for Masonry Structures	Table 1705.7, 2104.2, 2112.1.1

TPI

Truss Plate Institute Inc.
Suite 200
583 D'Onofrio Drive
Madison, Wisconsin 53719

Standard reference number	Title	Referenced in 780 CMR Section number
PCT-80	Design Specification for Metal Plate Connected Parallel Chord Wood Trusses	2305.14.1, 2313.3.2, 3605.2.10, 3608.2.11
TPI 1-95	National Design Standard for Metal Plate Connected Wood Truss Construction	2305.15 , 2313.3.1, 3605.2.10, 3608.2.11
TPI BWT-76	Bracing Wood Trusses: Commentary and Recommendations	3605.2.10, 3608.2.11
TPI QST-89	Quality Standard for Metal Plate Connected Wood Trusses	3605.2.10, 3608.2.11

UL

Underwriters Laboratories, Inc.
333 Pfingsten Road
Northbrook, Illinois 60062

Standard reference number	Title	Referenced in 780 CMR Section number
10A-93	Standard for Safety Tin- Clad Fire -with Revisions through May 1985	716.2
14B-93	Standard for Safety Sliding Hardware for Standard, Horizontally Mounted Tin-Clad Fire Doors -with Revisions through October 1984	716.2
14C-93	Standard for Safety Swinging Hardware for Standard Tin-Clad Fire Doors Mounted Singly and in Pairs -with Revisions through October 1984	716.2
55A-83	Material for Built-up Roof Coverings (Revised 1989)	3609.7.2
103-94	Standard for Safety Chimneys, Factory Built, Residential Type and Building Heating Appliance -with Revisions through February 1989	720.6.4, 3612.2
127-88	Standard for Safety Factory-Built Fireplaces -with Revisions through June, 1992.	720.6.4
181-90	Factory-Made Air Ducts and Air Connectors (Revised November, 1990)	3619.1.2
181A-90	Closure System for Use with Rigid Air Ducts and Connectors	3619.1.2
217-93	Standard for Safety Single and Multiple Station Smoke Detectors -with Revisions through February 1989	409.5.1
268-89	Standard for Safety Smoke Detectors for Fire Protective Signaling Systems -with Revisions through May 1989	409.5.1
441-86	Gas Vents	3612.2
555-95	*Fire Dampers*	717.1
559-85	Heat Pumps (Revised December, 1987)	3614.2.1
580-94	Standard for Safety Tests for Uplift Resistance of Roof Assemblies -with Revisions through December 1989	1505.2.2
641-86	Low-Temperature Venting Systems, Type L	3612.2
790-83	Tests for Fire Resistance of Roof Covering Material (Revised, 1989)	3609.1.3
910-95	Standard for Safety Test for Flame Propagation and Smoke-Density Values for Electrical and Optical-Fiber Cables used in Spaces Transporting Environmental Air	2805.2.5
997-81	Standard for Safety Wind Resistance of Prepared Roof Covering Materials -with Revisions through July, 1981	1505.2.3
1040-71	Outline of Investigation for Insulated Wall Construction	3603.17.3
1096-86	Electric Central Air Heating Equipment (Revised January, 1988)	3614.1.12
1256-85	Standard for Safety Fire Test of Roof Deck Constructions	.2603.4.1.5
1715-94	Fire Test of Interior Finish Material -with Revisions through March 1991	2603.8, 3603.17.3
1777-88	Chimney Liners (Revised November, 1989)	3610.2.14

Standard reference number	Title	Referenced in 780 CMR Section number
1040-89	Outline of Proposed Investigation for Insulated Wall Construction	2603.8
1820-94	Standard for Safety Fire Test Pneumatic Tubing for Flame and Smoke Characteristics - with Revisions through April 1991	2805.2.6
1887-95	Fire Tests of Plastic Sprinkler Pipe for Flame and Smoke Characteristics	2805.2.1

USC

United States Code
c/o Superintendent of Documents
U.S. Government Printing Office
Washington, D.C. 20402-9325

Standard reference number	Title	Referenced in 780 CMR Section number
Title 18; Chapter 40-70	Importation, Manufacture, Distribution and Storage of Explosive Materials	307.2

WWPA

Western Lumber

Standard reference number	Title	Referenced in 780 CMR Section number
WWPA-92	Western Lumber Span Tables for Floor and Ceiling Joists and Roof Rafters	3608.2.2

780 CMR Appendix B

Appendix B contains the following information and documentation;

Appendix B-1

A) Sample Uniform Building Permit Application Form for One and Two Family Dwellings and Accessory Buildings. This application form is not mandated by 780 CMR, however, the information requested on the form is the minimum information required to satisfy 780 CMR 110.4.

B) Sample Uniform Building Permit Application Form for Any Building Other than One and Two Family Dwellings and Accessory Buildings. This application form is not mandated by 780 CMR, however, the information requested on the form is the minimum information required to satisfy the requirements of 780 CMR 110.4.

Appendix B-2

Application Forms required to file an appeal with the State Building Code Appeals Board in accordance with 780 CMR 122.0.

Appendix B-3

Official Interpretations of the Building Code issued by the BBRS under authority of M.G.L. c 143, § 94(e). These interpretations have been made over the period since the promulgation of the first Edition of 780 CMR on January 1, 1975. Interpretations are identified by number, in order of interpretation, followed by the year of the interpretation. The edition of 780 under which the interpretation was made is indicated for each *Official Interpretation*.

APPENDIX B-1

SAMPLE BUILDING PERMIT APPLICATION FORMS

The following sample building permit application forms have been developed to simplify the building permit application process for the applicant and provide the building department with sufficient detail. in a standardized and concise form. Wherever possible the forms utilize a check off process for ease of use.

The sample application forms also reference certain Massachusetts General Laws which impact the issuance of the building permit.

The primary objective in the development of these application forms is to promote standardization throughout the Commonwealth. Standardization will benefit both the building permit applicant and the building department.

The sample application forms are not mandatory, but their use is strongly suggested. The information contained on the sample application forms, however, is the minimum required to be contained on a building permit application consistent with 780 CMR 110.4.

Application forms have been developed for;

- One and two family dwellings and accessory buildings thereto and;
- All other buildings and structures.

The Commonwealth of Massachusetts
State Board of Building Regulations and Standards
Massachusetts State Building Code
780 CMR

FOR MUNICIPALITY USE

APPLICATION TO CONSTRUCT, REPAIR, RENOVATE OR DEMOLISH A ONE OR TWO FAMILY DWELLING

This Section For Official Use Only

Building Permit Number: ____________ Date Issued: ____________

Signature: ____________ ____________
Building Commissioner/Inspector of Buildings Date

SECTION 1 - SITE INFORMATION

1.1 Property Address:

____

____

1.2 Assessors Map & Parcel Number:

____________ ____________
Map Number Parcel Number

1.3 Zoning Information:

____________ ____________
Zoning District Proposed Use

1.4 Property Dimensions:

____________ ____________
Lot Area (sf) Frontage (ft)

1.5 Building Setbacks (ft)

Front Yard		Side Yards		Rear Yard	
Required	Provided	Required	Provided	Required	Provided
		/	/		

1.6 Water Supply (M.G.L. c. 40, § 54)
Public ☐ Private ☐

1.7 Flood Zone Information:
Zone:______ Outside Flood Zone ☐

1.8 Sewage Disposal System:
Municipal ☐ On site disposal system ☐

SECTION 2 - PROPERTY OWNERSHIP/AUTHORIZED AGENT

2.1 Owner of Record:

____________ ____________
Name (Print) Address for Service:

____________ ____________
Signature Telephone

2.2 Authorized Agent:

____________ ____________
Name (Print) Address for Service:

____________ ____________
Signature Telephone

SECTION 3 - CONSTRUCTION SERVICES

3.1 Licensed Construction Supervisor:

Not Applicable ☐

____
Licensed Construction Supervisor:

____
License Number

____
Address

____
Expiration Date

____________ ____________
Signature Telephone

3.2 Registered Home Improvement Contractor:

Not Applicable ☐

____
Company Name

____
Registration Number

____
Address

____
Expiration Date

____________ ____________
Signature Telephone

SECTION 4 - WORKERS' COMPENSATION INSURANCE AFFIDAVIT (M.G.L. c. 152, § 25C(6))

Workers Compensation Insurance affidavit must be completed and submitted with this application. Failure to provide this affidavit will result in the denial of the issuance of the building permit.

Signed Affidavit Attached Yes....... ☐ No...... ☐

SECTION 5 - DESCRIPTION OF PROPOSED WORK (check all applicable)

New Construction ☐	Existing Building ☐	Repair(s) ☐	Alteration(s) ☐	Addition ☐
Accessory Bldg. ☐	Demolition ☐	Other ☐ Specify: ______		

Brief Description of Proposed Work:

______

______

______

______

SECTION 6 - ESTIMATED CONSTRUCTION COSTS

Item	Estimated Cost (Dollars) to be completed by permit applicant	Official Use Only	
1. Building		(a) Building Permit Fee Multiplier	
2. Electrical		(b) Estimated Total Cost of Construction from (6)	
3. Plumbing		**Building Permit Fee (a) x (b)**	
4. Mechanical (HVAC)			
5. Fire Protection			
6. Total = (1 + 2 + 3 + 4 + 5)		Check Number	

SECTION 7a - OWNER AUTHORIZATION - TO BE COMPLETED WHEN OWNERS AGENT OR CONTRACTOR APPLIES FOR BUILDING PERMIT

I, ______, as Owner of the subject property

hereby authorize ______ to act on my behalf, in all matters relative to work authorized by this building permit application.

______ ______
Signature of Owner Date

SECTION 7b - OWNER/AUTHORIZED AGENT DECLARATION

I, ______, as Owner/Authorized Agent hereby declare that the statements and information on the foregoing application are true and accurate, to the best of my knowledge and belief.

Signed under the pains and penalties of perjury.

______
Print Name

______ ______
Signature of Owner/Agent Date

The Commonwealth of Massachusetts
State Board of Building Regulations and Standards
Massachusetts State Building Code
780 CMR

FOR MUNICIPALITY USE

APPLICATION TO CONSTRUCT, REPAIR, RENOVATE, CHANGE THE USE OR OCCUPANCY OF, OR DEMOLISH ANY BUILDING OTHER THAN A ONE OR TWO FAMILY DWELLING

This Section For Official Use Only

Building Permit Number: ____________________ Date Issued: ____________________

Signature: ______________________________ ____________________
Building Commissioner/Inspector of Buildings Date

SECTION 1 - SITE INFORMATION

1.1 Property Address:

____

____

1.2 Assessors Map & Parcel Number:

______________ ______________
Map Number Parcel Number

1.3 Zoning Information:

______________ ______________
Zoning District Proposed Use

1.4 Property Dimensions:

______________ ______________
Lot Area (sf) Frontage (ft)

1.5 Building Setbacks (ft)

Front Yard		Side Yards		Rear Yard	
Required	Provided	Required	Provided	Required	Provided
		/	/		

1.6 Water Supply (M.G.L. c. 40, § 54)
Public ☐ Private ☐

1.7 Flood Zone Information:
Zone:________ Outside Flood Zone ☐

1.8 Sewage Disposal System:
Municipal ☐ On site disposal system ☐

SECTION 2 - PROPERTY OWNERSHIP/AUTHORIZED AGENT

2.1 Owner of Record:

______________________________ ______________________________
Name (Print) Address:
______________________________ ______________________________
Signature Telephone

2.2 Authorized Agent:

______________________________ ______________________________
Name (Print) Address:
______________________________ ______________________________
Signature Telephone

SECTION 3 - CONSTRUCTION SERVICES FOR PROJECTS LESS THAN 35,000 CUBIC FEET OF ENCLOSED SPACE

3.1 Licensed Construction Supervisor: Not Applicable ☐

____
Licensed Construction Supervisor:
____
Address
______________________________ ______________
Signature Telephone

____
License Number
____
Expiration Date

3.2 Registered Home Improvement Contractor: Not Applicable ☐

____
Company Name
____
Address
______________________________ ______________
Signature Telephone

____
Registration Number
____
Expiration Date

SECTION 4 - WORKERS' COMPENSATION INSURANCE AFFIDAVIT (M.G.L. c. 152 § 25C(6))

Workers Compensation Insurance affidavit must be completed and submitted with this application. Failure to provide this affidavit will result in the denial of the issuance of the building permit.

Signed Affidavit Attached Yes......☐ No......☐

SECTION 5- PROFESSIONAL DESIGN AND CONSTRUCTION SERVICES - FOR BUILDINGS AND STRUCTURES SUBJECT TO CONSTRUCTION CONTROL PURSUANT TO 780 CMR 116 (CONTAINING MORE THAN 35,000 C.F. OF ENCLOSED SPACE)

5.1 Registered Architect:

		Not Applicable ☐
Name (Registrant):		Registration Number
Address		Expiration Date
Signature	Telephone	

5.2 Registered Professional Engineer(s):

Name		Area of Responsibility
Address		Registration Number
Signature	Telephone	Expiration Date
Name		Area of Responsibility
Address		Registration Number
Signature	Telephone	Expiration Date
Name		Area of Responsibility
Address		Registration Number
Signature	Telephone	Expiration Date
Name		Area of Responsibility
Address		Registration Number
Signature	Telephone	Expiration Date

5.3 General Contractor

Company Name:		Not Applicable ☐
Responsible In Charge of Construction		
Address		
Signature	Telephone	

SECTION 6 - DESCRIPTION OF PROPOSED WORK (check all applicable)

New Construction ☐	Existing Building ☐	Repair(s) ☐	Alteration(s) ☐	Addition ☐
Accessory Bldg. ☐	Demolition ☐	Other ☐ Specify: ____________________		

Brief Description of Proposed Work: ____________________

____

____

____

SECTION 7 - USE GROUP AND CONSTRUCTION TYPE

USE GROUP (Check as applicable)								CONSTRUCTION TYPE	
A Assembly	☐	A-1	☐	A-2	☐	A-3	☐	1A	☐
		A-4	☐	A-5	☐			1B	☐
B Business	☐							2A	☐
E Educational	☐							2B	☐
F Factory	☐	F-1	☐	F-2	☐			2C	☐
H High Hazard	☐							3A	☐
I Institutional	☐	I-1	☐	I-2	☐	I-3	☐	3B	☐
M Mercantile	☐							4	☐
R Residential	☐	R-1	☐	R-2	☐	R-3	☐	5A	☐
S Storage	☐	S-1	☐	S-2	☐			5B	☐
U Utility	☐	Specify: ____________________							
M Mixed Use	☐	Specify: ____________________							
S Special Use	☐	Specify: ____________________							

COMPLETE THIS SECTION IF EXISTING BUILDING UNDERGOING RENOVATIONS, ADDITIONS AND/OR CHANGE IN USE

Existing Use Group: ____________________	Proposed Use Group: ____________________
Existing Hazard Index 780 CMR 34): ____________________	Proposed Hazard Index 780 CMR 34): ____________________

SECTION 8 BUILDING HEIGHT AND AREA

BUILDING AREA	Existing (if applicable)	Proposed
Number of Floors or stories include basement levels		
Floor Area per Floor (sf)		
Total Area (sf)		
Total Height (ft)		

SECTION 9- STRUCTURAL PEER REVIEW (780 CMR 110.11)

Independent Structural Engineering Structural Peer Review Required Yes......☐ No......☐

SECTION 10a - OWNER AUTHORIZATION - TO BE COMPLETED WHEN OWNERS AGENT OR CONTRACTOR APPLIES FOR BUILDING PERMIT

I, ____________________, as Owner of the subject property

hereby authorize ____________________ to act on my behalf, in all matters relative to work authorized by this building permit application.

____________________ ____________________

Signature of Owner Date

SECTION 10b - OWNER/AUTHORIZED AGENT DECLARATION

I, ______________________________, as Owner/Authorized Agent hereby declare that the statements and information on the foregoing application are true and accurate, to the best of my knowledge and belief.
Signed under the pains and penalties of perjury.

____
Print Name

______________________________ ______________________________
Signature of Owner/Agent Date

SECTION 11 - ESTIMATED CONSTRUCTION COSTS

Item	Estimated Cost (Dollars) to be completed by permit applicant	Official Use Only	
1. Building		(a) Building Permit Fee Multiplier	
2. Electrical		(b) Estimated Total Cost of Construction from (6)	
3. Plumbing		**Building Permit Fee (a) x (b)**	
4. Mechanical (HVAC)			
5. Fire Protection			
6. Total = (1 + 2 + 3 + 4+ 5)		Check Number	

Appendix B-2

State Building Code Appeals Board Filing Instructions and Application Forms

The Commonwealth of Massachusetts
Executive Office of Public Safety
State Board of Building Regulations and Standards
McCormack State Office Building
One Ashburton Place - Room 1301
Boston, Massachusetts 02108

TEL: (617) 727-3200 FAX: (617) 227-1754

WILLIAM F. WELD
Governor

KATHLEEN M. O'TOOLE
Secretary

KENTARO TSUTSUMI
Chairman

THOMAS L. ROGERS
Administrator

STATE BUILDING CODE APPEALS BOARD - FILING INSTRUCTIONS

Note: Appeals are held pursuant to 801 CMR 1.02 Informal/Fair Hearing Rules

The procedure outlined below must be followed when filing a Building Code Appeal:

1. The appellant must be in receipt of a letter of denial from the local Building Official as required under 780 CMR 111.1 of the State Building Code. An appeal must be filed within 45 days of the date of the letter of denial. An appeal may be filed either with the local **Building Code Appeals Board**, if one has been established, or directly with the State Building Code Appeals Board.

2. Two documents are required to be completed by the appellant or his/her representative - the **Appeal Application Form** (2 pages) and the **Service Notice** (1 page).

The **Service Notice**, which gives notice to the building official that an appeal is being filed, should include the date appearing on the appeal form and the name and address of the Building Official under the section "PERSON/AGENCY SERVED".The **Method of Service** should list one of the following procedures as set forth in Section 121.2.1 of the State Building Code.

A. Personally; or
B. Registered or Certified Mail, return receipt requested; or
C. By any person authorized to serve civil process.

The **Date of Service** is the date when a copy of the appeal is delivered or mailed to the Building Official or other party entitled.

The **Service Notice** must be signed by the appellant or his/her representative and the signature must be notarized.

The **Appeal Application Form** (2 pages) must be completed in total. The application will be reviewed for completeness prior to a hearing being scheduled. Applications determined to be incomplete will be returned to the applicant for correction. Questions relating to completing the application should be directed to your local building department or this office.

3. One complete copy of the appeal filing, including the original of the **Service Notice**, must be delivered to the Building Official or the official entitled. Four complete copies of the appeal filing, including the original plus three copies of the **Appeal Application** form, four copies of the **Service Notice** and four copies of the letter of denial, together with a check for **$150.00** (filing fee)payable to the Commonwealth of Massachusetts must be filed with this office, if the appeal is made directly to the State Building Code Appeals Board. (Filing fee requirements for filings before a local Building Code Appeals Board may differ from the fees prescribed for submission to the State Building Code Appeals Board).

**ALL CASES WILL BE HEARD ON THE SCHEDULED DATE
POSTPONEMENTS WILL NOT BE GRANTED.**

The Commonwealth of Massachusetts

Executive Office of Public Safety

State Board of Building Regulations and Standards

McCormack State Office Building

One Ashburton Place - Room 1301

Boston, Massachusetts 02108

WILLIAM F. WELD
Governor

KATHLEEN M. O'TOOLE
Secretary

TEL: (617) 727-3200 FAX: (617) 227-1754

KENTARO TSUTSUMI
Chairman

THOMAS L. ROGERS
Administrator

STATE USE ONLY
Fee Received: ______________
Check No.: ______________
Received By: ______________

STATE BUILDING CODE APPEALS BOARD APPEAL APPLICATION FORM

DOCKET NUMBER: ______________________ DATE: ________________
(State Use Only)

The undersigned hereby appeals to the State Board of Building Regulations and Standards from the decision of the:

Building Official from the City/Town of: ________________________________

Board of Appeals from the City/Town of: ________________________________

Other Municipal Agency/Official entitled: ________________________________

State Agency/Official entitled: ________________________________

OTHER: ________________________________

Dated: __________ 19 ____, having been aggrieved by such (check as appropriate)

Interpretation ○ Order ○ Requirement ○ Direction ○
Failure to Act ○ Other ○ Explain ________________________________

All appropriate code sections must be identified. **All written supporting documentation must be submitted with this application. Parties may present written material at the hearing. However, the Board reserves the right to continue the proceeding if such material warrants extensive review.**

State Briefly desired relief:
____
____

APPELLANT: ________________________________

ADDRESS FOR SERVICE: ________________________________
________________________________ Telephone No. ______________

ADDRESS OF SUBJECT PROPERTY: ________________________________
____

APPELLANT'S CONNECTION TO SUBJECT PROPERTY: ______________________

________________________________ ________________________________
SIGNATURE OF APPELLANT/REPRESENTATIVE **(NAME - PLEASE PRINT)**

DESCRIPTION OF BUILDING OR STRUCTURE RELATIVE TO THE MASSACHUSETTS STATE BUILDING CODE (780 CMR 6th EDITION): (Check as appropriate)

Check Here if Building is a One or Two Family Dwelling ☐ Proceed to section entitled "*Brief Description of the Proposed Work*" - Do not complete the tables below

DESCRIPTION OF PROPOSED WORK (check all applicable)

New Construction ☐	Existing Building ☐	Repair(s) ☐	Alteration(s) ☐	Addition ☐
Accessory Bldg. ☐	Demolition ☐	Other ☐ Specify: ______		

Brief Description of Proposed Work:

______

______

______

______

______

______

USE GROUP AND CONSTRUCTION TYPE

USE GROUP (Check as applicable)					CONSTRUCTION TYPE	
A Assembly	☐	A-1 ☐	A-2 ☐	A-3 ☐	1A	☐
		A-4 ☐	A-5 ☐		1B	☐
B Business	☐				2A	☐
E Educational	☐				2B	☐
F Factory	☐	F-1 ☐	F-2 ☐		2C	☐
H High Hazard	☐				3A	☐
I Institutional	☐	I-1 ☐	I-2 ☐	I-3 ☐	3B	☐
M Mercantile	☐				4	☐
R Residential	☐	R-1 ☐	R-2 ☐	R-3 ☐	5A	☐
S Storage	☐	S-1 ☐	S-2 ☐		5B	☐
U Utility	☐	Specify: ______				
M Mixed Use	☐	Specify: ______				
S Special Use	☐	Specify: ______				

COMPLETE THIS SECTION IF EXISTING BUILDING UNDERGOING RENOVATIONS, ADDITIONS AND/OR CHANGE IN USE

Existing Use Group: ______	Proposed Use Group: ______
Existing Hazard Index (780 CMR 34): ______	Proposed Hazard Index (780 CMR 34): ______

BUILDING HEIGHT AND AREA

BUILDING AREA	Existing (if applicable)	Proposed
Number of Floors or stories include basement levels		
Floor Area per Floor (sf)		
Total Area (sf)		
Total Height (ft)		

Brief Description of the Proposed Work:

______

______

______

______

The Commonwealth of Massachusetts
Executive Office of Public Safety
State Board of Building Regulations and Standards
McCormack State Office Building
One Ashburton Place - Room 1301
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Chairman

THOMAS L. ROGERS
Administrator

STATE BUILDING CODE APPEALS BOARD - SERVICE NOTICE

I, ______________________________, as ____________________ for the

Appellant/Petitioner ____________________________________ in an appeal filed with the

State Building Code Appeals Board on ________________, 19____

HEREBY SWEAR UNDER THE PAINS AND PENALTIES OF PERJURY THAT IN ACCORDANCE WITH THE PROCEDURES ADOPTED BY THE STATE BOARD OF BUILDING REGULATIONS AND STANDARDS AND SECTION 122.3.1 OF THE STATE BUILDING CODE, I SERVED OR CAUSED TO BE SERVED, A COPY OF THIS APPEAL APPLICATION ON THE FOLLOWING PERSON(S) IN THE FOLLOWING MANNER:

NAME AND ADDRESS OF PERSON/AGENCY SERVED	METHOD OF SERVICE	DATE OF SERVICE
______________________		
______________________	________________	______________
______________________		
______________________		
______________________	________________	______________
______________________		

____
Signature: APPELLANT/PETITIONER

On the __________ Day of ________________ 19____, PERSONALLY APPEARED

BEFORE ME THE ABOVE NAMED ____
(Type or Print the Name of the Appellant)

AND ACKNOWLEDGED AND SWORE THE ABOVE STATEMENTS TO BE TRUE.

______________________ ______________________
NOTARY PUBLIC MY COMMISSION EXPIRES

ENERGY CONSERVATION MANDATORY CHECKLIST FOR NEW CONSTRUCTION (OTHER THAN LOW-RISE RESIDENTIAL) 780 CMR, 1301.8.1

Owner/Agent Name: ____________________ Phone: __________

Owner/Agent Address: ____________________

City/State/Zip: ____________________

Project Name: ____________________

Site Address: ____________________ City/Town __________

Applicant's Name: ____________________ Signature: __________

Applicant's Phone: ____________________ Date of Application: __________

I. Envelope Compliance Option (check ONE)

☐ **Trade-Off** (1304.5) - Attach software Compliance Report (COMcheck-EZ)

☐ **Appendix J** (1301.2 - For buildings up to 10,000 sf only) - Attach Appendix J compliance documentation

☐ **Systems Analysis** (1309) - Attach Registered Architect's or Engineer's report

☐ **Prescriptive** (1304.2) - Complete this section, and attach copy of applicable Table (1304.2.1 through 13.4.2.12)

Climate Zone (from Table 1303.1) ☐ Zone 12a ☐ Zone 13a ☐ Zone 14a

a. Gross above-grade wall area ____________sq.ft.

b. Total window & glass door area ____________sq.ft.

c. Glazing % (100 x b÷a) ________% Table # utilized: ________

II. HVAC (check ONE)

☐ Simple Systems & Equipment (1305.2) ☐ Complex Systems & Equipment (1305.3)

☐ Systems Analysis (1309) - Attach Registered Architect's or Engineer's report

---

III. Lighting (check ONE)

☐ Building Area Method (1308.6.2.1)
☐ Space-by-Space Method (1308.6.2.2) } Attach Compliance Documentation (COMcheck-EZ or other)
☐ Systems Analysis (1309) - Attach Registered Architect's or Engineer's report

---

IV. Approval & Acceptance Construction Documents (1301.8.4.1)

Attach a narrative report describing the HVAC, Lighting, and Electric Distribution systems, including:

For Official Use ONLY:

Building Official check off completed sections of report

☐ 1. Design Intent
☐ 2. Basis of Design
☐ 3. Sequence of operation / systems interaction
☐ 4. Description of the systems (capacities, etc.)
☐ 5. Testing requirements / criteria acceptance
☐ 6. Requirement for submittal of operation manuals and maintenance manuals
☐ 7. Requirement for submittal of record drawings and control documents

This Side For Use by Building Department Only

Official's Name: ______________________________ Title: ____________________

I. Plans Review

Date Application Received: ______________________________

☐ Complete Narrative Report Received (1301.8.4.1)

☐ Design and Specification Documents prepared by legally recognized professional (1301.8.4.3)

Application is: Approved ☐ Date: ____________ Signature: ______________________

Denied ☐ Date: ____________

Reason(s) for Denial: (provide additional details as needed on separate sheet)

II. Acceptance (1301.8.4.4)

☐ Successful system tests witnessed by Building Official, **OR** ☐ satisfactory test report received (check one)

☐ Certification by Registered Professional (per 780 CMR 116.2) that systems are installed in accordance with construction documents

☐ Confirmation by owner (or their authorized representative) that they have received record drawings, reviewed for reasonable accuracy

☐ Confirmation by owner (or their authorized representative) that they have received reports, controls documentation, operations manual(s), maintenance manual(s), and other documents specified in 1301.8.4.1

Building Official's Signature: ______________________________

CONSUMER INFORMATION FORM - "SUNROOMS"

Massachusetts State Building Code (780 CMR, Appendix J, Section J1.1.2.3.1)

The Massachusetts State Building Code *(780 CMR)* includes provisions to ensure that houses and house additions meet energy efficiency standards. This supplemental CONSUMER INFORMATION FORM is to be filed as part of the building permit application when a builder/contractor or homeowner, constructing/installing a house addition with very large percentage of glass to opaque wall, seeks to utilize a special energy conservation exemption option for "sunroom" additions to an existing house (780 CMR, Appendix J, Section J1.1.2.3.1). This FORM is not intended to prevent a homeowner from selecting a "sunroom" of any size, configuration, orientation, form of construction or percent glazing, but rather is only intended to assist homeowners in becoming aware of some of the important energy conservation and year-round comfort considerations involved in selecting and utilizing a "sunroom" addition.

The connection of "sunroom" structures to residential buildings may create comfort and energy consumption issues due to uncontrolled solar gain or uncontrolled radiation cooling of the main house. In the selection and construction/installation of "sunrooms", included below is a non-required, open-ended list of product and design considerations that a homeowner may wish to consider before actually constructing/installing a "sunroom". It is recommended that consumers carefully review these options with their designer, builder, or contractor, in order to minimize potential energy consumption and/or house discomfort issues. In addition, the qualifications and reputation of the company or individuals to be hired are important considerations.

PRODUCT AND DESIGN CONSIDERATIONS RELATED TO "SUNROOMS"

- **Solar Orientation and Natural Shading**
- **Type of Glazing**
  - **Insulating value**
  - **Solar heat gain**
  - **Frame materials**
  - **Glazing to frame sealing and gasketing materials/ seal durability and/or weather tightness of the sunroom**
- **Adequate ventilation - Operable windows and fans**
- **Applied Shading Systems**
- **Insulation level in floors, walls, and ceilings**
- **Possible Sunroom isolation from the main house via a wall and/or door or slider**
- **Heating and Cooling Methods: Efficiency, Zoning and Controls**

Homeowner Acknowledgment

The Massachusetts State Building Code, Section J1.1.2.3.1, requires that the actual property owner (not the owner's agent or representative) acknowledge receipt of this CONSUMER INFORMATION FORM prior to issuance of a Building Permit for a project that includes "sunroom" additions to an existing residential building. In accordance with this requirement, the undersigned hereby acknowledges that she/he has read the information in this document concerning sunroom comfort and energy conservation.

Signature of Actual Building Owner	Date
Print Name	Address of Permitted Project
Owner Address (if different than project location)	Owner's telephone number

Official Interpretation No. 1-85

DATE: October 30, 1985

SUBJECT: State Building Code Section 108.5.1

Question 1: Section 108.5.1 requires the periodic inspection of certain buildings, and the issuance of Certificates of Inspection for these buildings on a regular basis. The standard form Certificate of Inspection which was developed by the Commonwealth states that "The means of egress are sufficient for the following number of persons:" and provides space for the listing of permitted occupancy load by story and by place of assembly. Is it the intent of the Code to require a complete periodic reinspection of the entire building or is such an inspection limited to the building's egress system?

Answer 1: No. Section 108.5.1 states in part "A Certificate of Inspection as herein specified shall not be issued until an inspection is made certifying that the building or structure or parts thereof complies with ALL the applicable requirements of this Code ..." (emphasis supplied). The periodic reinspection is not necessarily limited to the building's egress system but may extend throughout to the entire building, or parts thereof requiring certification. The Certificate of Inspection serves as a spot check to ensure that other Code mandated procedures have been followed (e.g. permits obtained for alterations) and that the building has been maintained in a safe condition. The building has been maintained in a safe condition. The building official is free to use his judgment in determining how extensive a periodic inspection need be.

Question 2: Do Code requirements for periodic reinspection include a requirement to reinspect by wiring, plumbing, gas fitting and elevator inspectors for compliance with the various applicable specialized codes?

Answer 2: No. The Massachusetts State Building Code does not include a requirement for periodic reinspection by plumbing, wiring, gas fitting or other various specialized code enforcement officials. However, periodic inspections conducted by the building official may reveal conditions that would require further attention by local wiring, plumbing, gas or elevator inspectors.

Question 3: May a professional consultant assume or be granted the powers and duties of the Building Official to issue permits and certificates or may he merely submit a report for the Building Official's review and acceptance?

Answer 3: Section 114.1 states in part, "The Building Commissioner or Inspector of Buildings shall examine or cause to be examined all applications for permits and amendments thereto within 30 days after filing. ... If he is satisfied that the proposed work conforms to the requirements of this Code and all pertinent law applicable thereto, he shall issue a permit." Only a Building Official, appointed in accordance with Section 107 to enforce the building code may issue building permits and/or related certificates. A professional consultant may submit a report for the Building Official's review, but the issuance or denial of the permit or certificate is ultimately the Building Official's responsibility.

Question 4: May such a professional consultant be hired by a municipality to perform inspections in the absence of any "unusual technical issues" as described in Section 108.5, or should the consultant more properly be engaged by the building owner in the absence of unusual technical issues?

Answer 4: A professional consultant or expert retained by a municipality in the absence of any "unusual technical issues" to perform inspections would be required to meet the criteria and qualifications outlined in M.G.L. c. 143, § 3, and would be deemed a local inspector, and subject to all pertinent requirements of Code and law. However, a Building Official may review and/or accept reports from other qualified personnel, per Section 111.2.1 (see Question 3).

Question 5: What, if any, liability under the Code would a municipality assume in utilizing a professional consultant for the various functions described above?

Answer 5: Opinions relative to broad legal questions of liability are beyond the purpose and scope of the Board of Building Regulations and Standards. Therefore, we must decline to answer this question, and would direct the municipality to its legal advisor(s) for such and opinion.

Official Interpretation No. 2-85

DATE: October 30, 1985

SUBJECT: State Building Code Section 119.3

Question 1: Do All existing buildings have a legal use group classification , whether in use or not?

Answer 1: Yes. Section 202.1 states "All buildings and structures shall be classified with respect to use in one (1) of the use groups listed...". The use group classification is based on the purpose for which a building or structure is designed, used or intended to be used. A use group classification is required to be assigned to a building or structure whether in actual use or not.

Question 2: On what is the legal use based?

Answer 2: The Massachusetts State Building Code defines use as "The purpose for which the building or structure is designed, used or intended to be used." The lawful use and/or use group classification of an existing building may be based upon the Building Official's records pertaining to the particular structure. In the case of a vacant structure, the last legal use of record would apply.

Question 3: Does the legal use change or cease to exist when ownership changes?

Answer 3: No. A change in ownership of a building would not change the use group classification of the building or cause the use to cease. A change of use and/or occupancy may take place regardless of ownership when done in accordance with a permit issued by the Building Official.

Does the use have any relationship with ownership?

The use and ownership are only related in that the owner, as defined by Code, is responsible to comply with the applicable sections of the Code as regard to use, and must obtain a permit to change the use of a building.

Question 4: Is there ever any such thing as "abandonment" of a use group classification, so that an existing building has no use group?

Answer 4: No. All buildings are required to be classified with respect to their use. The discontinuance or "abandonment" of the actual using of a building or structure would not change the use group classification. For example, a vacant office building (formerly legally occupied) would remain in use group "B" (Business Buildings), the last lawful use of the building, until a permit was obtained to change that use.

Question 5: Upon request by an owner for a certificate of use and occupancy, is the Building Official obligated to cite in writing any violation of law or orders pending?

Answer 5: Yes. If there are violations of law or orders pending, the provisions of Section 121.0 would apply. Section 121.2.1 states that every notice or order authorized by this Code shall be in writing and shall be served on the person responsible.

Question 6: Can the use of a building or portion of a building, subsequent to January 1, 1975, legally change without the issuance of a building permit and a certificate of use and occupancy?

Answer 6: No. Section 113.0 and Section 113.1 state that a permit is required "...to change the use or occupancy of a building or structure...".

Section 119.0 and Section 119.2 state " A building or structure, in whole or in part, altered to change from one use group to another: to a different use within the same use group...shall not be occupied or used until the certificate shall have been issued certifying that the work has been completed in accordance with the provisions of the approved permits...".

The Massachusetts State Building Code became effective on January 1, 1975. All changes of use or occupancy subsequent to January 1, 1975 would be subject to the provisions of the Code.

Official Interpretation No. 3-85

DATE: October 30, 1985

SUBJECT: State Building Code Section 609.3

Massachusetts State Building Code Section 609.2 requires not less than two approved independent exitways serving every building except as modified in Section 609.3.

Massachusetts State Building Code Section 609.3 also allows one exitway in a building of the use group and characteristics as specified in Table 609.

Massachusetts State Building Code Section 609.3 also allows one exitway from the first story of a building when the first story is 2,000 square feet or less in area and with an occupancy load not exceeding 50 persons. Egress from other stories shall comply with Article 6.

Massachusetts State Building Code Section 609.2 also specifies not less than two approved independent exitways serving every story, except in one and two family dwellings and as modified in Section 609.3.

It is our interpretation that Section 609.3 deals with two distinct and separate building design configurations. In its first essence, Section 609.3 provides for certain buildings (those complying with Table 609)which are required to have only one exitway. The remaining sentences in Section 609.3 describe conditions (less than 50 occupants and less than 2,000 square feet in area) in which the first story only of any building is required to have only one exitway. Table 609 does not relate to the latter case.

Official Interpretation No. 4-85

DATE: October 30, 1985

SUBJECT: State Building Code Table 214 and Section 217.4

An existing three story building is proposed to be of type 3-C constriction. The exterior walls have a fire separation of 30 feet or more and the walls themselves are non-bearing. The loads are carried by a structural steel frame and there are structural beams and columns within the exterior wall which are part of the load bearing system. Therefore, the steel frame is load bearing. The walls themselves are essentially curtain walls.

Question: Are the beams and columns which are on the exterior part of the building, required as load bearing members, to have a two hour fire rating?

Answer: No. Table 214, line 8 of the State Building Code establishes the fire resistance rating required for the columns and framing(beams) and does not require a fire resistance rating for columns or beams for the proposed condition. However, it should be noted that, per Section 911.6, beams which support walls required to be fire resistance rated must be protected to afford not less than the fire resistance rating of the wall supported and, when supporting masonry walls, must carry a minimum fire resistance of one hour. Further, it should be noted that, if the framing supports a required fire separation wall such as an exitway enclosure, Section 909.4 would require this framing to be protected to afford a fire resistance rating equal to the wall supported.

Official Interpretation No. 5-86

DATE: January 28, 1986

SUBJECT: State Building Code Section 2101.10.4.2

Question: In a single family dwelling, the (nominal) width of a second means of egress doorway is required by Section 2101.10.4.2 to be a minimum of 32 inches. Does a six foot wide sliding glass door providing a net clear opening of 29 ¾ inches comply with this requirement?

Answer: Yes. Section 2101.10.2 allows the use of sliding glass doors for egress. Section 612.3 of the Code allows means of egress doorways to have a minimum clear width of 28 inches in one- and two-family dwellings. Per Sections 857.5.6.1 (Item 2) and 2101.7.2 (Item 2) of the Code, and Massachusetts General Laws (M.G.L.) Chapter 143, Section 3T, safety glass must be used in these sliding glass doors. M.G.L., c. 143, § 3U requires that safety glazing be etched or otherwise permanently identified as such.

Official Interpretation No. 6-86

DATE: January 28, 1986

SUBJECT: State Building Code Section 909.1.2

Question: Is it the intent to require a fire separation wall and/or fireresistive floor-ceiling assembly between units which has a fire rating of one hour, that is, an assembly with one face in one unit and the opposite face in another unit, with an assembly between the two faces producing a fireresistance rating of one hour, or, a one hour fire rated assembly for each dwelling unit, which in effect, produces a two hour fire rated assembly between the two dwelling units?

Answer: It is the intent of Section 909.1.2 to require a one hour rated dwelling unit separation between dwelling units, rather than a one hour rated assembly per dwelling unit.

Official Interpretation No. 7-86

DATE: January 28, 1986

SUBJECT: State Building Code Table 214, Line 7 "Dwelling Unit Separations and other Non-Bearing Partitions"

Question: Does Table 214, Line 7, control the fireresistance rating of only the vertical dwelling unit separations, with Line 10 controlling the horizontal separation?

Answer: No. Table 214, Line 7, regulates the fireresistance rating required between dwelling units. A rating of not less than one hour is required to be provided between dwellings regardless of their orientation and type of construction. If a certain type of construction is required by Table 214, Line 10 to provide a greater fireresistance rating for floor-ceiling assemblies, this assembly may also serve as the dwelling unit separation required by Table 214, Line 7.

Official Interpretation No. 8-86

DATE: August 19, 1986

SUBJECT: State Building Code Section 607.3

Question: Section 607.3 requires that building exitways be "...as remote from each other as practicable." Do so-called "scissor stairways" which are constructed side-by-side, usually located in the center of a building, violate this requirement?

Answer: No. Section 607.3 also states that exit stairways must be "...arranged to provide direct access in separate directions from any point in the area served." Scissor stairways, especially when located in a center core, may well satisfy Section 607.3. The exit access passageways or corridors must provide direct access to the stairways in separate directions. Because the entrances to the scissor stairways are usually at opposite sides of the core, they may, in fact, be as remote as practicable and accessible in separate directions. Table 214, Line 4, provides fire resistance requirements for enclosure of the exitways, and Table 214, Line 6, and Section 610.4 specifies fireresistance requirements for exitway access corridors.

Official Interpretation No. 9-86

DATE: August 26, 1986

SUBJECT: State Building Code Sections 504.2 and 1009.2

Question: Does the Code allow the usage of flexible duct and duct connector in forced hot air heating systems for residential construction?

Answer: Yes. Sections 504.2 and 1009.2, which speak to the use of ductwork for heating and ventilating, make reference to the mechanical code listed in Appendix B of the State Building Code, which is the BOCA Basic Mechanical Code, 1978 edition. In Sections M-301.4.3 through M-301.4.5 flexible duct and duct connector are permitted for all occupancies except one and two family dwellings when conforming to the UL 181 standards, and subject to other limits stated therein. Section M-302.2.1 allows non-metallic supply ducts in one and two family dwellings when in conformance with the applicable standard (UL 181 or SMACNA-75) listed in the appendix of the Mechanical Code.

Official Interpretation No. 10-86

DATE: August 27, 1986

SUBJECT: State Building Code Sections 1004.0 and 1006.0

Question: Must condensing type oil-fired furnaces (central heating appliances) always be vented into masonry chimneys?

Answer: No. The purpose of the masonry chimney requirement is to provide safe venting of the high temperature exhaust gasses generated by conventional type oil-fired central heating appliances. However, certain condensing type oil-fired furnaces generate low temperature exhaust gases which also contain corrosive products that can adversely effect masonry. Consequently, condensing type oil-fired furnaces which operate to produce vent gas temperatures of no greater than 150°F are to be approved for through-wall and/or through-roof venting with polyvinylchloride or similar pipe when installed according to the manufacturer's recommendations. The appliance and its venting system must have been tested together and "listed" or the provisions of Section 1006.0 for "unlisted appliance" apply.

Official Interpretation No. 11-87

DATE: December 30, 1986

SUBJECT: State Building Code Section 2108.3.2

Question: Do chimney lining and/or re-lining systems which do not use fire-clay flue lining (ASTM C315) require specific approval by the State Board of Building Regulations and Standards?

Answer: No. Section 2108.3.2 of the Code permits the use as chimney lining of, "...other approved material that will resist corrosion, softening or cracking from flue gasses at temperatures up to 1700° Fahrenheit."

Materials and/or systems which satisfy the high temperature provisions of the Underwriters' Laboratory Test Standard 103 (UL-103 HT) satisfy this performance requirement for lining of masonry chimneys contained in Section 2108.3.2.

Since each system is tested in the configuration required by the manufactures' installation instructions, these instructions become the requirements for installation of the chimney lining system.

Official Interpretation No. 12-87

DATE: February 24, 1987

SUBJECT: State Building Code Sections 616 and 2101

Question: Are alternating tread stairways, such as the Lapeyre Stair, permitted by Massachusetts State Building Code as an element of required means of egress?

Answer: No. The exit stairway requirements described in Sections 616 and 2101 of the Code are intended to provide a stairway of certain minimum exit capacity, with the full width being available for occupant egress, at an incline that results in motion familiar to the occupants. Alternate tread stairways are intended for use where floor space is limited and therefore a steeper than usual incline is required. The steeper incline, when descending the stairway, requires an unfamiliar foot motion more downward and less outward than that typically required. Imposing such an unfamiliar motion on occupants exiting the building during a life threatening situation is unwarranted.

The Lapeyre Alternating Tread Stair exceeds the maximum incline permitted by Sections 616 and 2101 and will, therefore, require an unfamiliar motion by the occupants.

In addition, the overall width of these stairs does not meet the minimum width requirement of Sections 616 and 2101, nor would the exit capacity be equal to that of a full stairway if the minimum width were satisfied since these stairs do not permit parallel egress of individuals.

The Lapeyre Alternating Tread Stair is, therefore, not permitted as an element of a required means of egress.

Official Interpretation No. 13-88

DATE: October 25, 1988

SUBJECT: State Building Code Section 2108

Question: A single family dwelling is to be constructed with a fuel-fired water heater in the basement and a fireplace lined with a 2 inch thick refractory brick on the first floor. What construction is required to separate the water heater flue from the firebox and smoke chamber of the fireplace at the first floor? What separation is required within the chimney?

Answer: Section 2108.7.2 requires that the firebox of a fireplace constructed of solid masonry and lined with refractory brick have back and side walls of at least 8 inches total thickness.

Section 2108.7.4.5 requires that the walls of the smoke chamber be a minimum of eight inches thick. Thus a minimum of eight inches of solid masonry is required in these locations. Once the elevation of the fireplace flue is reached, Section 2108.3.2.4 allows two adjoining flues to be contained in the same chimney, so long as the flue liner joints are staggered at least seven inches. If this staggering of flue liner joints is not provided, or if more than two flues are present, Section 2108.3.2.5 requires that masonry flue partitions of at least four inch thickness, bonded into the chimney walls, be constructed to separate the flues.

Official Interpretation No. 14-89

DATE: March 28, 1989

SUBJECT: State Building Code Section 437 and 616.8

Question 1: Section 437.1.3.2 provides that "At least one required exitway shall be accessible without passage through an atrium." Section 437.2.2, which speaks to the enclosure of atriums, contains an exception which provides that "The adjacent spaces of any three (3) floors of the atrium shall not be required to be separated from the atrium; however, these spaces shall be included in the atrium volume according to Section 437.2." Is it the intent of Section 437.1.3.2 to require at least one required exitway to be accessible without passage through an atrium on those floors exempted by Section 437.2.2 from the requirement for separation from the atrium?

Answer 1: No. The exception in Section 437.2.2 allows the designer to eliminate atrium separations on any three floors so long as the additional spaces on these floors are added to the atrium volume for purposes of sizing the smoke control requirements of the atrium. What this allowance essentially does is to add these adjacent spaces to the atrium. It is impossible to provide an exit which is accessible without passage through an atrium for spaces within that atrium. The provisions of Section 437.1.3.2 are intended to ensure that spaces outside the atrium need not depend on the viability of the atrium in order to gain access to an exitway. Therefore, these provisions are not applicable for any spaces which are already included in the atrium space, including those spaces added when the exception in Section 437.2.2 is applied.

Question 2: Is it the intent of the Code that stairways conforming to Section 616.8 and escalators conforming to Article 16 be subject to the requirements of Section 437.3.1?

Answer 2: Not necessarily. It is intended that unenclosed supplemental stairways be prohibited from connections with (required) exit stairways and exitway access corridors, and that these unenclosed supplemental stairways be equipped with a draft stop conforming to Section 437.3.1. While there are no provisions in the Code text to require that escalators be classified and protected as floor openings, it is possible that escalators can be so classified. However, escalators may also be enclosed in fire resistance rated construction, or may be located within an atrium. A supplemental stairway may also be enclosed in fire resistance rated construction, or may be located in an atrium, and may therefore not be classified as a floor opening.

Sequential Gap - Official Interpretation Number 15

Official Interpretation No. 16-89

DATE: August 29, 1989

SUBJECT: State Building Code Sections 616

Question: Does the installation of a handicapped stair lift in a required exit stairway constitute an obstruction to the means of egress?

Answer: Yes. Section 616 of the State Building Code makes the following provisions:

"Stairways shall not reduce in width in the direction of exit travel. Projections into a stairway are prohibited except for handrails as indicated in Section 616.5.1 and for stairway stringers which may project not more than one and one-half inches." (616.2.3)

"The least dimension of landings and platforms shall be not less than the required width of stairway." (616.3.1)

"Stairways shall have continuous guards and handrails on both sides..." (616.5)

"An exitway enclosure shall not be used for any purpose other than means of egress." (616.9.2)

Moreover, Section 605 states that "It shall be unlawful to obstruct, or reduce in any manner, the clear widths of any doorway, hallway, passageway or any other exitway required by the provisions of this code." Section 605 also requires that "All required means of egress components shall at all times be maintained in a safe usable condition."

Handicapped stair lifts installed in required egress stairs can conceivably violate all of the above sections. When in use, such lifts render at least a portion of a stairway unusable. Even when not in use, the lift equipment projects into the required width, interferes with the use of handrails, and presents a potential tripping hazard to persons using the stair. Also, the introduction of this equipment into a stair enclosure does, in a sense utilize an exitway enclosure as an elevator shaft, and there is the possibility that the equipment, motor, and wiring can catch fire, thereby rendering the exitway unusable. There is also reason to expect that loss of primary electrical power in an emergency situation could disable the lift in a position where it would present a greater obstruction than when not in use. For these reasons, we conclude that the installation of inclined stairway chairlifts in required exitway stairways is potentially hazardous, and is therefore not permitted. However, the building official may allow the installation of such lifts in stairways which are not a component of the required means of egress, so long as the building official determines that the particular installation is not hazardous. It is the policy of the Department of Public Safety, Division of Inspection, Elevator Section to require a letter of approval from the building official before granting a permit for an inclined stairway chairlift.

Official Interpretation No. 17-89

DATE: October 24, 1989

SUBJECT: State Building Code Section 1216

Question: Under the new (ASME/ANSI A 17.1) elevator code, smoke detectors are required in the elevator lobby for elevator control. Are these same smoke detectors required to be tied into the fire alarm system?

Answer: Yes. NfiPA 72A, the applicable fire protection standard referenced in Section 1216.1, requires that these detectors be tied into the fire alarm system.

Official Interpretation No. 18-90

DATE: February 27, 1990

SUBJECT: State Building Code Section 1006.2

Question: Is the "direct venting" (through-the-sidewall combustion product exhaust venting) of "listed" comfort heating and comfort cooling appliances allowed in lieu of venting to a masonry chimney as required in Section 1004 of the State Building Code?

Answer: Yes, Section 1006 of the State Building Code (the Code) defines "listed appliances" and Section 1006.2 addressing appliances to be vented states:

> - "Appliances shall be connected to a listed venting system or provided with other means for exhausting the flue gasses to the outside atmosphere in accordance with the venting system selection chart contained in the mechanical code listed in Appendix B."

In Section 1001.2, the Code recognizes that appliances required to be vented "shall be connected to a vent or chimney..." and in Section 1002 addresses the performance test and acceptance criteria to insure safe and proper performance of the venting system.

Direct venting systems that are "listed" or are part of a listed appliance conform to the requirements of the Code.

Official Interpretation No. 19-90

DATE: December 11, 1990

SUBJECTS: of Section 602.1 of the Fifth Edition of the State Building Code and, BBRS Approval of the Use of Power Venters

In order to immediately correct an inadvertent oversight in Section 602.1 of the Fifth Edition of the State Building Code, at is meeting of November 20, 1990, the Board unanimously voted that it should reflect the provisions of M.G.L. c. 148, §§ 26A and 26A½ and, therefore, should read -

602.1 Applicability: the provisions of this section shall apply to all buildings more than 70 feet above mean grade, except that the provisions of this section shall not apply to airport traffic control towers conforming to the requirements of Section 616.0.

By way of clarification, Section 602.1, as cited in the Fifth Edition, is in conflict with statutory requirements of 2 counts:

1. It ties high rise provisions to floors used for human occupancy and located more than 70 feet above the lowest level of fire department vehicle access; whereas, the governing statues identify high rise buildings as all buildings of more than 70 feet in height above the mean grade; and
2. The cited section in the Fifth Edition measures from the lowest level of fire department vehicle access; whereas, the statutes measure from mean grade.

As you know, statutory requirements govern and in this case also reference the high rise provisions of the State Building Code.

POWER VENTERS

Power Venters, as contained in Section 2513 of the Fifth Edition, are ONLY allowed for use WITH GAS OR OIL FIRED comfort heating and/or cooling appliances. Approval from the BBRS is required for use with solid fuel burning appliances.

Official Interpretation No. 21-91

DATE: July 30, 1991

SUBJECT: Section 908.1 of the Fifth Edition of the State Building Code as related to attached dwelling units (Use Group R-3), in which the units are separated by interior lot lines.

Question: a) When side by side attached single family dwelling units (Use Group R-3) are constructed such that the exterior wall of each is located at the lot line which divides them, will two one-hour rated wood stud walls comply with Section 908.1 (Fire Walls and Party Walls) of the 5th Edition of the Code?

b) Could the two walls referred to in question a) above be supported on a single foundation wall.

Answer: a) For multiple attached single family dwelling units, (Use Group R-3), which are separated by interior lot lines, the intent of section 908.1 is satisfied by the construction of a single fire separation wall having a fireresistance rating of one-hour. Such fire separation walls may be used between attached dwelling units providing that the wall construction meets the requirements of Section 910 and the sound transmission ratings of Section 714. and that the allowable area limitations between fire walls of Table 501 are not exceeded. Fire walls, constructed in accordance with Section 908, are required when the allowable area limitations of table 501 are reached. (e.g. 4800 sf per floor for multiple attached single family dwelling units, Use Group R-3).

b) The wall referenced in answer a) above may be supported one a single concrete or masonry foundation wall of equivalent or greater fire resistance rating.

Discussion: Section 908.1 of the Code requires party walls to be constructed as fire walls if an interior lot line is present. Furthermore, the fire walls "....shall be constructed of any approved noncombustible materials providing the required strength and fireresistance rating specified in Table 401 for the type of construction, but not less than the fire grading of the use group specified in Table 902. Strength.....".

The argument can be made that such party walls can be considered to be exterior walls, thus causing the requirements of section 908.1 to be in conflict with the exterior wall fireresistance requirements of Table 906.2 (for fire separations of five feet or less).

Table 906.2 requires an exterior wall fireresistance rating of one hour for a fire separation distance of zero feet. If two dwelling units were constructed on adjacent lots and each were constructed on the common lot line, such that the fire separation distance of each unit was zero, Table 906.2 would require each exterior wall to have a fireresistance rating of one hour. However, Code requirements for multiple single family attached dwelling units when interior lot lines are not present, table 401 would simply require the construction of *dwelling unit separation* walls with a fireresistance rating of one hour, between dwelling units. It would appear to be inconsistent to require the same R-3 structure to have a greater degree of fire safety due simply to the separation of the dwelling units by an imaginary lot line.

Official Interpretation No. 22-91

DATE: September 24, 1991

SUBJECT: Section 2102.4(1) of the Fifth Edition of the State Building Code as it relates to reconstruction in Coastal High Hazard Areas following Storm Damage.

At a regular meeting of the Board of Building Regulations and Standards held on Tuesday 24, September 1991, the Board approved the following interpretation of Section 2102.4(1) of the 5th Edition of the Massachusetts State Building Code, effective immediately.

Question: When a structure is located in a Coastal High Hazard Area ("V" zone) and is swept from its foundations during a storm, and the building remains intact but the foundation system is completely destroyed, does the code require that the structure be constructed on an elevated pile foundation, in accordance with Section 2102.4 ?

Answer: Yes. The structure, as described would be considered to be substantially damaged and as such would be required to be provided with a new foundation system. Section 3203.3, the foundation system would constitute a "new system", as defined in Section 3201 and therefore would be required to be constructed to meet the requirements for new construction. Since the structure is located within a "V" zone, Section 2102.4(1) would require the structure to be elevated on piles.

Question: When a structure is located in a Coastal High Hazard Area ("V" zone) and is swept from its foundations during a storm, and both the building and foundation system remain intact and if the costs associated in relocating the building onto its existing foundation system are less than 50% of the market value of the structure prior to the damage, does the code require that the structure be constructed on a raised pile foundation, in accordance with Section 2102.4 ?

Answer: No. If both the foundation system and structure are intact and the cost associated in relocating the structure to its pre-damaged condition, then the structure is permitted to be relocated on the existing foundation unless, in the opinion of the building official, under Section 101.3, the proposed reconstruction would constitute an unsafe structural condition, in which case the structure should be elevated in accordance with Section 2102.4(1).

Official Interpretation No. 23-91

DATE: September 30, 1991

SUBJECT: Section 816 of the Fifth Edition of the State Building Code as It Relates to Requirements for Stairways

Date of Interpretation:

The State Board of Building Regulations and Standards, at it's regular monthly meeting of September 24, 1991, affirmed the following requirements:

Question: To what extent are the provisions of Massachusetts State Building Code, Section 816, applicable to a stairway providing access to an attic area in a business establishment; said attic area used for the storage of stock used in conjunction with that business?

Answer: Section 816, INTERIOR STAIRWAYS, (in conjunction with Section 819, EXTERIOR STAIRWAYS), of the Fifth Edition of the Massachusetts State Building Code requires that all stairways, whether interior or exterior, required or supplemental, must be so constructed to satisfy the applicable requirements imposed for interior exit stairways.

This means that for interior or exterior, required or supplemental stairways, the width, headroom, stairway allowed width restrictions, the allowed dimensions of platforms and landings, the acceptable vertical rise between landings and platforms, riser height and tread depth and the dimensional uniformity required between adjacent risers and treads and the requirements for stairway guards and handrails are controlled by the requirements of Section 816.

Note 1: If classified as a mezzanine, then the subject attic area would fall under the requirements of Section 605 of the State Building Code; otherwise such area would be treated as an additional story of the building, with the resulting classification determining what applicable State Building Code requirements apply.

Note 2: Only fixed interior or exterior, required or supplemental stairways (dimensions and handrail/guardrail requirements) are controlled by Section 816 - ladder type stairs and "pull-down", non-fixed stair systems are not explicitly regulated by the Building Code.

Note 3: Article 34, Section 3401, still controls dimensions and handrail/guardrail requirements for fixed stairways in one and two family detached dwellings.

Official Interpretation No. 24-92

DATE: January 28, 1992

SUBJECT: Section 1205 of the Fifth Edition of the State Building Code as it relates to Frost Protection for Fence Posts

At a regular meeting of the Board of Building Regulations and Standards held on Tuesday 28, January, 1992, the Board approved the following interpretation of Section 1205 of the 5th Edition of the Massachusetts State Building Code, effective immediately.

Question: Is it the intent of the Code to require a four foot deep concrete footing to the posts of a fence up to six feet in height ?

Answer: No. The requirement of section 1205, which requires protection against frost for footings for permanent structures is not applicable to minor fences such as described in the above question.

In certain fence applications, post embedment depths of four feet or more may indeed be required for fences of unusual size, or fences which are subjected to unusual loading conditions (such as a prison security fence, for instance which, in addition to wind loads, may also be subjected to vehicle impact loads). However, it is not the intent of the Code to require frost protection for fences which are only four feet in height.

As an example consider the construction of a four foot high chain link fence, erected as a property line demarcation. The required post embedment depth is determined by a number of factors including; the height of the fence; the applied horizontal loads; the nature of the soil and; the intended function of the fence. Specific reference related to post embedment depths can be found in ASTM F 567-84 " Standard Practice for Installation of Chain Link Fence", and although not specifically referenced in the Code, is a recognized national standard of practice. Sections 4.1 and 4.8 of ASTM F 567-84 specify *minimum* post embedment depths of 24 inches and 36 inches, for concrete encased and driven posts, respectively, when used in the construction of a four foot high chain link fence. For this particular type of fence, it is unlikely that movement due to frost heave would result in a life safety hazard or cause serious damage. However, it is incumbent upon the designer to make this determination on a site specific basis (and to submit his determination to the local building official for approval) and prepare the design accordingly.

In summary, the intent of the Code relating to these issues is expressed in Section 311.0, USE GROUP U, UTILITY AND MISCELLANEOUS USES, which states ..." *Buildings and Structures of an accessory character ... shall be constructed equipped and maintained to meet the requirements of this code* ***commensurate with the fire and life hazard incidental to their use.*** [emphasis added] *Utility and miscellaneous uses shall include fences over 6 feet high, tanks, cooling towers, retaining walls and buildings such as private garages, carports, sheds and agricultural buildings".* The phrase *"commensurate with the fire and life hazard incidental to their use"* is the key phrase to consider, as it provides the necessary guidance to the designer and building code official to avoid the "blanket" literal interpretation of the requirements of Section 1205 and other inappropriate sections of the Code.

Official Interpretation No. 25-92

DATE: January 28, 1992

SUBJECT: Section 921.6.2 of the Fifth Edition of the State Building Code as it relates to Firestopping.

At a regular meeting of the Board of Building Regulations and Standards held on Tuesday 28 January, 1992, the Board approved the following interpretation of Section 921.6.2 of the 5th Edition of the Massachusetts State Building Code, effective immediately.

Question: In a building which has suspended ceilings and vertical partitions extending to the underside or suspended horizontal membrane of the ceiling, is it the intent of Section 921.6.2 to require firestopping at the top of the partitions to eliminate the open connection between the vertical wall openings and the horizontal ceiling space ?

If firestopping is required, is the requirement applicable to combustible and noncombustible construction?

Answer: If the vertical partition does not penetrate the ceiling membrane, (i.e. if the partition terminates at the underside of the plane of the ceiling) there is effectively no connection between the horizontal space above the ceiling and the vertical space within the partition, therefore firestopping is not required. If, however, the vertical partition penetrated the plane of the ceiling, firestopping would be required at the interface of the ceiling and partition. For this situation, the firestopping would be required whether the partition and ceiling materials were combustible or noncombustible.

Official Interpretation No. 26-92

DATE: January 28, 1992

SUBJECT: Sections 706.1 and 707.1 of the Fifth Edition of the State Building Code as related to Mechanical Ventilation of Non Public Bathrooms

At a regular meeting of the Board of Building Regulations and Standards held on Tuesday 28, January, 1992, the Board approved the following interpretation of Section 706.1 and 707.1 of the 5th Edition of the Massachusetts State Building Code, effective immediately.

Question: Can a bathroom exhaust fan exhaust into an enclosed ventilated attic space which has soffit vents in conjunction with continuous ridge vents or eaves vents.

Answer: No. Section 707.1 requires that " Mechanical ventilation, when provided, shall conform to the requirements of the BOCA National Mechanical Code listed in Appendix A, unless expressly defined within this Code, and may be substituted for the requirements for natural ventilation."

Article 16 of the BOCA National Mechanical Code (1987) lists the required mechanical ventilation air in Table 1602.2.

Section M-1604.1 (Mechanical Exhaust) of the BOCA National Mechanical Code (1987) states, in part, that **".... The exhaust shall discharge directly to an approved location on the exterior of the building".**

Warm, moist air exhausted from bathroom spaces would condense in the cooler attic space, even if the attic space were adequately ventilated. Moisture from condensation will eventually cause damage to wood framing members (or sheathing), insulation and ceiling materials and may pose a threat of fire if electrical circuitry is contacted.

Sequential Gap 27 and 28

Official Interpretation No. 29-92

DATE: January 12, 1993

SUBJECT: Articles 6, 8 and 9 - Smoke Protection in Egress Corridors of Fully Suppressed Buildings

Question 1: In a fully sprinklered building, is it the intent of Section 810.4.1 of the Fifth Edition of the Massachusetts State Building Code (the Code) that egress corridors be constructed so as to serve as an effective barrier to limit the transfer of smoke?

Answer 1: Yes, for USE GROUPS where *"sleeping uses"* are involved.

The BOCA National Building Code/1987 Commentary, for Section 810.4.1 (the Massachusetts Code, utilizes the BOCA Building Code language for this Section) states that Section 810.4.1 "...acknowledges that an automatic fire suppression system can serve to control or eliminate fire development which could threaten the exit access corridor. The nonsleeping occupancies are permitted to have nonrated corridors if the suppression system is installed throughout the area served by the corridor as well as the corridor itself". "In the sleeping uses ...the corridor fireresistance is reduced to one-half hour. The purpose of the fireresistance rated corridor is not only to provide a fire endurance capability, but mainly to provide a quality of construction that would ensure such walls would serve effectively as barriers to smoke. The dwelling unit (sleeping uses) separation walls, while reduced to ½ hour, are to be constructed tight to the ceiling above (tight to the underside of the floor/roof deck above or tight to the rated floor/ceiling assembly above), to complete the barrier to smoke function."

The interpretation provided above is not meant to imply that Section 810.4 requires satisfying Section 911 - "SMOKE BARRIERS", as "SMOKE BARRIERS" are unique to certain "defend-in-place" concepts, specifically associated with Section 610.5, I-2 USE.

Note that Section 810.4.1 does allow that when an approved fire suppression system is installed and supervised in accordance with Section 1020.1, parts 1, 2 or 3, and has its water flow alarm device connected to an approved central station system, proprietary system or remote station system of the jurisdiction, a fire resistance rating for exit access corridors, and tenant separation walls which are also corridor walls, is not required in USE GROUPS A, B, E, F, M and S.

Question 2: In a fully sprinklered building of USE GROUP I-2, is it the intent of Section 610.4 of the Fifth Edition of the Massachusetts State Building Code (the Code) that egress corridors be constructed so as to serve as an effective barrier to limit the transfer of smoke?

Answer 2: Yes - Section 610.4 clearly states that "...in buildings equipped throughout with an approved automatic fire suppression system, the corridor wall fireresistance rating is not required provided the corridor walls form a barrier to limit the transfer of smoke."

The BOCA National Building Code/1987 Commentary, for Section 610.4 (the Massachusetts Code, utilizes the BOCA Building Code language for this Section) states that "...if the building is protected throughout with an automatic fire suppression system, thereby reducing the possibility that a fire will develop which is life-threatening to persons outside the room of origin, the corridor walls need only be able to resist the passage of smoke."

"...when the building is protected with an automatic fire suppression system, the primary concern is to contain the smoke since the suppression system is expected to suppress and thereby contain the fire."

The interpretation provided above is not meant to imply that Section 610.4 requires satisfying Section 911 - "SMOKE BARRIERS", unless a wall of the exit access corridor is intended to be a "SMOKE BARRIER" wall. "SMOKE BARRIERS" are unique to certain "defend-in-place" concepts, specifically associated with Section 610.5, I-2 USE.

Question 3: In fully sprinklered buildings of USE GROUPS R-1, R-2 and I-2, is it the intent of the Code that smoke dampers be provided at duct penetrations through the unrated corridor walls?

Answer 3: No, provided in the case of the I-2 USE, the corridor wall is not a portion of a "SMOKE BARRIER" (Section 911.5 would require a smoke damper in a "SMOKE BARRIER"/I-2 USE).

Note that the Code is effectively silent on the use of "smoke dampers", but does provide guidance in Section 918, on the use of "fire dampers". Section 918.2 states that "fire dampers" shall be provided at locations where air distribution systems penetrate assemblies required to have a fireresistance rating", thus the R-1 and R-2 USES, having a one-half hour rating would require "fire dampers" but not smoke dampers" - the I-2 USE corridor walls, if not a portion of a "SMOKE BARRIER" - Section 911 - would not be rated and would not require a "fire damper".

Exceptions to Section 918.2 "fire damper" requirements include exception no. 3 to Section 918.2, where:

Exception 3 states that a fire damper is not required "...at penetrations of tenant separation and corridor walls in buildings equipped throughout with an approved automatic fire suppression system." Here, the 1987 Commentary states that "since an automatic fire suppression system reduces the potential for duct collapse, fire dampers are not required to protect penetrations of tenant separation and corridor walls in buildings protected throughout with an approved automatic suppression system."

Utilizing this same reasoning, a smoke damper would not be required as it is not expected that a fire can develop sufficiently in R-1 and R-2 or I-2 buildings that are fully suppressed, thus the level of "passive defense" required in corridor construction (where such corridor walls are not part of a "SMOKE BARRIER"/I-2 USE), is limited to the corridor walls being constructed tight to the ceiling above (tight to the underside of the floor/roof deck above or tight to the rated floor/ceiling assembly above), to complete the barrier to smoke function and thus limit the transfer of smoke in the exit corridors of these "sleeping occupancies.

Question 4: In fully sprinklered buildings of USE GROUP I-2, is it the intent of the Code to allow the use of flexible duct (designed, listed and installed per the requirements of Section M-303 of the BOCA National Mechanical Code/1987)?

Answer 4: Yes. As is noted in answers #1, #2, and #3 above, the Code now places great emphasis on "active defense" in the form of full suppression and would allow the use of flexible duct when designed, listed and installed per the BOCA National Mechanical Code/1987 and additionally satisfies the requirements of NFiPA-90A in the case of the I-2 USE.

Official Interpretation No. 30-93

DATE: March 9, 1993

SUBJECT: of Table 401, Item 12 of the Fifth Edition of the State Building Code as it relates to the Use of Skylights in Fire resistance Rated Roof Construction

Question: Is it the intent of the Code to allow the use of unrated skylights in roof construction that is required to have a fire resistance rating under the provisions of item 12 of table 401, by virtue of the type of construction and height from the floor to the lowest structural member ?

Answer: Yes. The intent of the fire resistance rating requirements of table 401 are (in protected construction) to offer a degree of protection to the structural members of the roof system in order to prevent premature structural collapse of the roof.

For a particular type of construction, the degree of fire resistance required by table 401 to be provided for the roof construction is consistent with the protection required for the remainder of the structural elements of the building. Damage caused to a skylight during a fire event will not promote premature structural collapse of a rated roof system.

Question: Is it the intent of the code to allow a roof assembly, which is required to be rated under table 401 (item 12), to be constructed wholly of non rated skylights.

Answer: Yes. Provided that the following conditions exist:

a. the structural members of the roof system are protected in accordance with the requirements of table 401;

b. the subject building does not require the roof to be rated under the provisions of section 906.5. If the roof system is required to be rated due to vertical protection issues of section 906.5, unrated skylights are prohibited from being located within 15 feet of the adjacent building.

Question: Are opening protectives required, in accordance with Section 906.5, for exterior wall openings which are located less than 15 feet vertically above the roof of an adjacent lower building, if the adjacent lower building has a roof assembly fire resistance rating of one hour or greater and the roof assembly contains unrated glass skylights ?

Answer: Yes. Section 906.5 requires opening protectives for exterior wall openings in an adjacent higher building if the openings are located less than 15 feet vertically above the lower roof and the adjacent buildings are separated horizontally by a distance less than 15 feet, unless the roof construction of the lower roof has a fire resistance rating of one hour or greater. Fire in the lower building may be a source of exposure to openings in an adjacent higher building if the fire were to breech the roof construction. If the roof of the lower building has a fire resistance rating which affords the degree of safety against collapse of the roof, the potential for spread of fire to the adjacent (and taller) building would exist if fire penetrated the skylights and if the skylights were located within 15 feet vertically and 15 feet horizontally of the skylight. Section 906.5 does not require exterior wall opening protectives, even if the lower adjacent roof assembly is unrated provided that the buildings are separated horizontally by a fire separation distance of over 15 feet.

Therefore skylights would be permitted in rated roof construction of the lower roof without the need for exterior wall opening protectives if either the buildings were separated horizontally 15 feet greater, if the skylights were a distance of 15 feet or more from the adjacent exterior wall, or if the adjacent exterior wall openings were greater than 15 feet above the lower roof level.

Official Interpretation No. 31-93

DATE: April 13,1993

SUBJECT: of Section 113.3 and Section 201.0 Definitions (owner) of the Fifth Edition of the State Building Code as it relates to the definition of owner.

Question 1: If a contractor is hired by an owner, is the contractor considered an agent under the definition of owner (Section 201.0) ?

Answer 1: Yes

Question 2: What information would be necessary to qualify that the contractor was an agent ?

Answer 2: The contractor would need to produce (1) a letter stating that he/she has been granted the authority to act as an agent or (2) a copy of a written contract signed by the owner and the contractor as specified.

Question 3: Can a city or town refuse to issue a permit to a contractor with (1) a letter stating that they may act as an agent or (2) with a signed contract between the two parties to remodel or construct a structure simply because he/she is not the owner of the structure or property ?

Answer 3: No. The definition of owner (Section 201.0 owner) states " Every person who alone or jointly or severally with others ......

(b) has care, charge or control of any building or structure in any capacity .....". The contractor is considered to have control, care or charge of the building during the time of construction as ling as the contractor has a letter stating that he/she is authorized to take out a permit (act as an agent of the owner) or the contractor has a signed contract with the owner.

Official Interpretation No. 32-93

DATE: May 14, 1993

SUBJECT: of Section 827.1 of the Fifth Edition of the Massachusetts State Building Code as it relates to when guardrails are required.

Question 1: Is the 30 inch elevation intended to be the limit above which guardrails are required to be installed in accordance with Section 827.1 ?

Answer 1: Yes. It is generally established in the BOCA National Building Code (1987) that when the height difference between the walking surface and the adjacent lower walking surface or grade is 30 inches or greater, guardrails are required to be provided.

Question 2: Is the 30 inch difference in elevation intended to be the point at which guardrails are required for ramps in addition to stairs or walking surfaces ?

Answer: No. Ramps are required to be provided with guardrails (if the ramp has an open side) irrespective of the difference in elevation between the ramp and the adjacent walking surface.

Official Interpretation No. 33-93

DATE: May 14, 1993

SUBJECT: Section 114.3 of the Fifth Edition of the Massachusetts State Building Code as it relates building permit extensions

Question: May a building official, if work has not begun as required under a building permit, within the six month period after the issuance of such permit, issue an extension of time for a period of more than six months.

Answer: No. Section 114.3 states that the building permit shall be considered abandoned unless the work authorized by it shall have commenced within six months after its issuance. Section 114.3 permits the building commissioner or inspector of buildings, for cause, to grant one or more extensions of time, for periods not exceeding six months. {emphasis added}.

Building permit extensions may be granted for periods of greater than six months by variance from a local or State Building Code Appeals Board pursuant to sections 126 of the Building Code.

Official Interpretation No. 34-93

DATE: September 28, 1993

SUBJECT: Requirements of the Fifth Edition of the Massachusetts State Building Code for "Permanent Foundations", "Frost-Protected Foundations" and the Building Inspector's Responsibilities Under "Doubtful Use Classification"

Question 1: Do Sections 1205.1 or 3402.3.4 of the Massachusetts State Building Code (the Code) mandate that all buildings and structures that are constructed, be placed on "permanent", frost-protected foundation systems?

Answer 1: No. Neither Section 1205.1, nor 3402.3.4 mandate permanent supports for all buildings and structures, but rather state that where permanent supports exist, they shall be frost-protected in a certain way (in order for supports to be considered "permanent", they must satisfy the requirements of either Section 1205.1 or 3402.3.4 of the Code).

Question 2: Does the State Building Code allow for other than frost-protected foundation systems or permanent foundation systems for new construction building and structures?

Answer 2: Yes.

(The issue of when such non-permanent foundation systems should be allowed, often arises when the Building Official is confronted with a "Doubtful Use" or "Utility Use" building - typically, storage sheds, carports, landscape type structures such as detached gazebos, etc.).

Question 3: As the Code does allow for other than frost-protected or permanent foundation systems in buildings and structures, what Code guidance is provided to assess whether or not frost-protected/permanent foundation systems are required for new construction buildings and structures?

Answer 3: Article 3 of the Code, Sections 301 through 313, address USE classification, and review of same will lead the reader to Sections 311.1 and 312.1 of the Code.

Section 311.1, in part, states: "Buildings and structures of an accessory character and miscellaneous structures not classified in any specific use group shall be constructed, equipped and maintained to meet the requirements of this code commensurate with the fire and life hazard incidental to their use. Utility and miscellaneous uses shall include... carports, sheds and agricultural buildings." (note underlining emphasis added).

Section 312.1, in part, states: "When a building or structure is proposed for a use not specifically provided for in this code, or the classification of which is doubtful, such building or structure shall be included in the use group which it most nearly resembles in respect to the existing or proposed life and fire hazard, and it shall be so classified by the building official." (note underlining emphasis added).

Review of these, Article 3 subsections, reveals that use classification, under utility or doubtful use, allows - in fact, mandates - that the Building Official make a judgement call and that the classification of use be commensurate with the fire and life hazard incidental to the use of the structure. On this basis, if, in the judgement of the Building Official (which is required to be made under Section 312.1), a utility type structure, such as a shed, would have a low fire and life hazard, the Building Official could allow a non-frost-protected, non-permanent foundation system.

Official Interpretation No. 35-94

DATE: April 12, 1994

SUBJECT: Referenced Standards adopted as listed in Appendix A.

Question: Some of the reference standards, as listed in Appendix A, give the local authority having jurisdiction the power to amend or vary the requirements of certain provisions contained within the standard. Does this mean that a building official may, (or the fire official, when reviewing plans pursuant to article 10) when requested, or on his or her own initiative, waive or vary said requirements.

Answer: No. The Board adopts the technical content of the reference standards, as written, but retains jurisdiction to adjudicate all variance requests pursuant to M.G.L. c. 143, § 100. The variance must be pursued through the appeals process pursuant to Section 126 of the Building Code and must be heard at the State level or by local or regional Building Code Appeals Board if local or regional boards exist within your jurisdiction.

Official Interpretation No. 36-94

DATE: April 12, 1994

SUBJECT: Design of Connections in Structural Steel Braced Frames - Sections 1113.5.2.2(a) and 1113.5.7.2

Question: What design force should be considered for the members of a braced frame constructed of structural steel?

Answer: The connection of members in a structural steel braced frame shall be designed for not less than the lesser of the following forces;

a. 1.25 times the force determined in accordance with Section 1113.4.1, without the allowable ⅓ (one third) stress increase or;

b. The full axial capacity of the member, based on 0.6 Fy multiplied by the member gross cross sectional area.

This is a minimum requirement and may be followed in lieu of Section 1113.5.7.2.

DATE: April 12, 1994

SUBJECT: **Formal Interpretation Number 36-94**

The seismic advisory committee, at its meeting of April 7, 1994, voted to approve the attached formal interpretation number 36-94 relating to the design of connections in structural steel frames. The request for the interpretation was submitted by Weidlinger Associates, Inc. on December 6, 1993.

Advisory Ruling No. 1-94

DATE: April 14, 1994

SUBJECT: Section 119.1 of the Fifth Edition of the Massachusetts State Building Code as it relates to the Issuance of the Certificate of Occupancy

Question: If a conflict occurs between a building official and other local agencies as to whether or not a certificate of use and occupancy (c/o) is to issue for a building or structure, what action should the building official take pursuant to Section 119.1 of the Fifth Edition of the Massachusetts State Building Code?

Answer: The building official has the authority to issue a c/o pursuant to Section 119.1. If a conflict is created with other local agencies as a result of the issuance of the c/o, the aggrieved party/parties may, in accordance with M.G.L. c.143, §100, appeal to the State Building Code Appeals Board. Any person aggrieved by a decision of the State Building Code Appeals Board may appeal to a court of law or equity in conformance with M.G.L. c.30A, §14.

Official Interpretation No. 38-94

DATE: August, 16, 1994

SUBJECT: Use of a Registered Professional Engineers Seal as Required under Section s 113.5.2 and 127

Discussion: Section 113.5.2 requires the seal of a qualified registered professional engineer or architect be con-tained on all plans and specifications for buildings and structures containing over 35,000 cubic feet of enclosed space. Additionally section 127.2.1 requires that all plans computations and specifica-tions involving new construction, alterations repairs, expansions or additions shall be prepared by ... a registered professional architect or engineer and shall bear his signature and seal ...

The Board of Registration of Professional Engineers and Land Surveyors (the Board of Registration) is the Board having statutory authority to register professional engineers in the Commonwealth of Massachusetts. The Board of Registration registers engineers by discipline, perhaps the those most related to the construction of buildings and structures being civil, mechanical, HVAC, structural, sanitary, electrical and fire protection.

Question 1: Consider the situation where a set of plans and specifications are filed with the building official at the permit application stage for an automatic fire suppression (sprinkler) system. The plans and specifications bear the seal and signature of a Massachusetts Registered Professional Structural (or any other discipline) Engineer. Do the plans, as filed comply with section 1113.5.2 and 127.2.1? Additionally, is it required that the discipline of the engineer to be shown on the plans?

Answer 1: The plans and specifications may be sealed by an engineer of any discipline with the following conditions;. The Board of Registration's regulations 250 CMR are the rules and regulations relating to the practice of engineering and land surveying.

The Board of Registration initially registers an engineer in one branch of engineering only, following a determination that the engineer has been found competent by education, experience and specific examination passed by the registrant. The branch of engineering in which the engineer is registered shall either be included as part of the seal, or shall be handwritten above the registrant's signature (250 CMR 3.05(2).

The Board of Registration's regulations 250 CMR 3.05(7) requires the engineer to limit professional practice to areas of professional competence as demonstrated to and approved by (emphasis added} the Board of Registration.

The Board of Registration does not limit the engineer to the discipline in which he/she is registered but allows the registrant to practice in branches of engineering outside that indicated on his/her seal provided that he he/she has demonstrated competence to the Board of Registration. (250 CMR 3.05(6) A registrant who wishes to practice engineering in an area of competence other than that in which registered may request a determination of competence by submitting such evidence as may be required by the Board of Registration). The Board of Registrations regulations mandate that the burden of proof of competence rests with the registrant should a question be raised as to that competence. The Board of Registration is the only authority empowered to determine competency and will do so if requested by the registrant or any person or entity. The entity could be a city or town and an individual could be the building official acting in his official capacity or acting as a private citizen.

Question 2: Under the requirements of construction control (section 127), does the building official (or the fire official when reviewing plans pursuant to Article 10) have to accept the seal of any Massachusetts registered professional engineer even if the discipline noted on said seal is not the discipline associated with the reports, design, plans or specifications under the building permit review ?

Answer 2: No, the building official (or the fire official when reviewing plans pursuant to Article 10) does not have to accept the seal. In the case where the seal is a different discipline than the work contained in the report, design, plans or specifications, or where the reviewing official believes there is a question of competency, the building official, may require that the registered professional engineer demonstrate competence, in accordance with the Board of Registration's regulations (250 CMR 3.05(6) or (7)). When the registrant's competency is questioned, it is incumbent upon the registrant to apply to the Board of Registration for a determination of competency. It is not the responsibility of the building (or fire) official to make a determination relative to competency, but it is perfectly permissible for a building (or fire) official to request that the registrant prove

THE MASSACHUSETTS STATE BUILDING CODE

Official Interpretation No. 39-94

DATE: July 12, 1994

SUBJECT: The Impact on the State Building Code Due to the May 17, 1994 Emergency Updating of Reference Standards in Appendix A (NFiPA Reference Standards)

Question 1: At its May 17, 1994 Public Hearing, the Board, via emergency adoption, updated numerous NFiPA reference standards in Appendix A of the Code - did the Board, by this action, intend to cause substantive changes to the explicit regulatory requirements of the Code proper?

Answer 1: No. The Board was simply updating Appendix A reference standards to reflect currently available NFiPA reference standards; there was no intention to change explicit requirements of the Code proper.

Question 2: As NFiPA 72-1993, the "NATIONAL FIRE ALARM CODE" is one of the reference standards that was updated at the May 17, 1994 Public hearing and as Section 2-2.1.1.1 of NFiPA 72-93 requires that in new residential construction, there be smoke detectors installed in each sleeping room, would this requirement supersede smoke detector requirements historically mandated by the Code?

Answer 2: No. As indicated in the response to the first question, above, there was no intention on the part of the Board to cause substantive changes to the explicit requirements of the Code when Appendix A reference standards were updated in May of 1994.

Also, Section 101.4 of Article 1 of the Code states that: "Where differences occur between provisions of this Code and referenced standards, the provisions of this Code shall apply."

In the case of smoke detector requirements for residential occupancies, Section 1018 of the Code is explicitly prescriptive relative to the required location for smoke detectors and therefore supersedes the installation requirements of NFiPA 72-93.

Official Interpretation No. 41-94

DATE: August 15, 1994

SUBJECT: Section 109.1.1.1 - The Use of Municipal Construction Supervisor Licenses in Municipalities Where Such Licensing was Established Prior to January 1, 1975

Background/Discussion:

Section 109.1.1.1 does not prohibit a municipality from requiring a license for individuals engaged in directly supervising persons engaged in construction, reconstruction, alteration...in those categories of buildings and structures for which the BBRS is not requiring a license.

Section 109.1.1.1 goes on to say; provided that those municipalities which have established licensing requirements for construction supervisors prior to January 1, 1975 may maintain their existing licensing requirements.

As a result of a Building Code Appeal, a BBRS Appeals Board, on March 18, 1992, unanimously agreed that no municipality can implement building licensing regulations that conflict with those promulgated by the Commonwealth. The City of Boston was ordered: (1) "to immediately issue appropriate building permits to the appellants, provided such work falls within the scope of their State Construction Supervisor's Licenses"; (2) "to immediately cease the illegal activity of denying building permits to holders of valid State Construction Supervisor's Licenses, provided such work falls within the scope of such State Construction Supervisor's Licenses"; and (3) to immediately cease the illegal activity of issuing building permits to holders of Boston Builders Licenses, but who do not hold a valid State Construction Supervisor's License, where such work falls within the scope of the State Construction Supervisor's License program."

Question: Considering the current practice of many Building Departments requiring a State Construction Supervisor's License (CSL) or a Municipal Construction License (of that Municipality, only) and where such Municipal License was established prior to January 1, 1975, is the Board, via the Board of Appeal ruling of March 18, 1992, ruling that all building permits awarded to holders of such Municipal Licenses are invalid and illegal?

Also, is it the Board's intent to propose a Code Change to Section 109.1.1.1 eliminating Construction Licensing by Municipalities when such Municipal Licensing was established prior to January 1, 1975?

Answer: The Board decision of March 18, 1992 was tied to the City of Boston refusing to issue building permits to holders of State CSL's and was based on the language of St. 1972, c. 802, § 75, which states "All by-laws and ordinances of cities and towns in conflict with the state building code shall cease to be effective on January 1, 1975."

The Board is charged with promulgating a single uniform building code for the Commonwealth and Section 109.1.1.1 of the Code is an explicit portion of said Code and may be formally interpreted by the Board. To this end, it is the Board's position that Section 109.1.1.1, for Municipalities that had appropriate construction supervisor licensing programs in effect prior to January 1, 1975, such Municipalities may maintain their existing practices of accepting either their local Municipal construction supervisor license or the State CSL - Note that a building permit may not be denied to holders of valid State CSLs (provided such work falls within the scope of the State CSL) even though such holders of the State CSL do not have the Municipal construction supervisor's license; also note that the holder of a local Municipal construction supervisor license may not utilize that license in another Municipality but must possess the State CSL when performing building permittable work within the scope of the State CSL in a community without a valid, local Municipal construction supervisor license program.

Official Interpretation No. 42-94

DATE: September 13, 1994

SUBJECT: Section 1011.2 - Acceptable Discharge Testing of Wet Chemical Range Hood Extinguishing Systems

Background/Discussion:

Section 1011.2, ***"TESTS"***, in part, states that: "a completed system shall be tested by a discharge of wet chemical in sufficient amounts to verify that the system is properly installed and functional."

In reality, that portion of the sprinkler installation industry installing specialized commercial kitchen suppression tests the various pre-engineered wet chemical systems, not by discharging wet chemical, but rather by utilizing pressurized gas - this industry approach allows for determination that piping to spray nozzle integrity exists and that nozzles are not blocked, but does not create a clean-up problem nor does such testing wet up the internals of the piping /nozzle system.

NfiPA 17A, ***"STANDARD ON WET CHEMICAL EXTINGUISHING SYSTEMS"***

and which is referenced in Section 1011 defines pre-engineered wet chemical extinguishing systems as those having predetermined flow rates, nozzle pressures, and quantities of liquid agent. Such systems may have specific pipe sizes, maximum and minimum pipe lengths. flexible hose specifications, number of fittings, and number and types of nozzles prescribed by a testing laboratory. The hazards protected by these pre-engineered systems are specifically limited as to type and size by a testing laboratory. Limitations on hazards that can be protected and piping and nozzle configurations are contained in the manufacturer's listed installation and maintenance manual which is part of the listing.

NfiPA 17A also notes that where required by the authority having jurisdiction, the approval tests shall include a discharge of wet chemical (such a test is not mandated, however, by NFiPA 17A) - the Standard further notes that the method of verification shall be acceptable to the authority having jurisdiction.

Discussions with a major manufacturer of pre-engineered wet chemical range hood extinguishing systems indicates that since the basic system is a pre-engineered listed product, acceptance testing of the entire wet chemical/piping/nozzle system need only consist of ensuring piping integrity and further ensuring that the installed nozzles are not blocked and a full, wet chemical discharge for acceptance testing of a pre-engineered system is not necessary and a simplified gas discharge test would suffice.

Question: For pre-engineered wet chemical range hood extinguishing systems as discussed in Section 1011 of the Code, is it acceptable to substitute a pressurized gas discharge test for the full wet chemical discharge test as required by Section 1011.2?

Answer: **YES**, for pre-engineered systems, since such systems are tested, listed systems, it is sufficient for acceptance testing that a simple gas discharge test that ensures down stream piping integrity and further ensures that spray nozzles are not blocked, would be an acceptable test approach since the intent of the Code is to ensure that the installed range hood extinguishing system is functioning.

Note that it would also be acceptable to test in accordance with the pre-engineered system manufacturer's recommendations.

Official Interpretation No. 43-95

DATE: May 9, 1995

SUBJECT: Section 600.3 - Impact of Section 600.3 on Egress Requirements of Sections 631, 636 and 638

Background/Discussion:

Section 600.3 is language excerpted directly from the 1987 BOCA National Building Code and directly adopted into the Fifth Edition of the Massachusetts State Building Code - it's noted that the requirements of Section 600.3 of the 1987 BOCA National Building Code were dropped in the 1990 version of the BOCA National Building Code and additionally, such requirements are also absent in the latest, 1993 BOCA National Building Code.

In the current Massachusetts State Building Code, Section 600.3 , *"MEANS OF EGRESS"* states: "The means of egress for buildings of special uses and occupancies shall conform to the requirements of Article 8, except as is modified by more restrictive provisions of this article for specific uses."

This language is sufficiently broad so that one current interpretation of this Section is to require in Section 631, 636 and 638 residences EXIT SIGNS and LIGHTS in accordance with Section 823 of Article 8 and MEANS OF EGRESS LIGHTING in accordance with Section 824 of the Code.

Section 631, "GROUP RESIDENCE"; Section 636, "LIMITED GROUP RESIDENCE"; and Section 638, "GROUP DWELLING UNITS" are sections of the Code that were developed on a consensus basis in conjunction with DMR/DMH/OFC** input and the specific requirements contained within these sections are intended to stand alone as express life-safety requirements for these special uses .

The adoption of Section 600.3 of the 1987 BOCA National Building Code was **not** intended to impose additional signage and lighting requirements in these dwelling units although should certain of these dwelling units be located, for example, in an R-2 USE apartment building, the common egress areas of the apartment building would be required by Code to possess exit signage and lighting appropriate to the building but exit signage and/or lighting for the dwelling unit proper and not expressly required by Section 631 or 636 or 638 would not be required in the dwelling unit.

** Department of Mental Retardation (DMR); Department of Mental Health (DMH); Office for Children (OFC)

Question: Does Section 600.3, *"MEANS OF EGRESS"* of the Code require that the requirements of Section 823, "EXIT SIGNS AND LIGHTS" and/or Section 824, "MEANS OF EGRESS LIGHTING" automatically be imposed on dwelling units falling under Sections 631, 636 and 638 respectively?

Answer: No. Numerous dwelling units with respect to Sections 631, 636 or 638 are found in one- or two-family buildings of R-4 or R-3 USE and it is not the intention of the Code to require exit signage or means of egress lighting in such dwelling units unless expressly required by the special Section. For example, the specific requirements of Section 636.3.3.10 requires MEANS OF EGRESS LIGHTING in accordance with Section 824, but nowhere in Section 636 is there a requirement for EXIT SIGNS and EXIT LIGHTS.

Residences licensed under Sections 631, 636 and 638 are defined as RESIDENTIAL USES and are **not** classified as INSTITUTIONAL USE; therefore only the lighting/signage requirements of 631, 636 and 638 proper are to be imposed on the dwelling units of these residences - note the deliberate term "dwelling unit" as opposed to the term "building". A Section 638 "GROUP DWELLING UNIT" , for example, could be found in an R-2 USE apartment building, and by Code, the common egress areas of the R-2 building would require exit signage, lights and means of egress lighting, but the Section 638 dwelling unit proper would not require such signage and lighting unless expressly required by Section 638 and /or other sections of Code expressly referenced in Section 638.

Official Interpretation No. 44-95

DATE: June 13, 1995

SUBJECT: Use Group Classification - *Warehouse-Mercantile* Buildings and Structures.

Discussion: Recent trends in retail marketing and sales have seen an upsurge in the numbers of the "*warehouse-mercantile*" type stores. These kinds of facilities utilize bulk storage on the actual sales floor area in racks. Commodities stored and sold range from hardware and household items through floorcoverings, cabinetry, lumber paint, adhesives and other building materials, flammables, aerosols, pool chemicals and fertilizers. The building typically functions as both a warehouse and a retail establishment, and the amounts of each type of product stored is typically orders of magnitude greater than a typical mercantile establishment. Furthermore, there is usually no dedicated storage area separate from gross sales area. Aisles are used for staging product prior to storage in the high rack storage system, in addition to merchandizing. Typically, mercantile stores which utilize separated storage and sales areas are designed as *mixed use* buildings, and conform to the separated or non separated requirements of the code. The increasingly popular trend of the *warehouse-mercantile* occupancies has raised a question as to which *use group* is most appropriate for such occupancies. Depending upon the amounts and types of product stored, it is possible that the building could consist of a variety of uses such as; *Mercantile* (*M*), *Low Hazard Storage* (*S-2*), *Moderate Hazard Storage* (*S-1*) and *High Hazard* (*H*) and/or other uses.

Question: Since the State Building Code does not specifically address warehouse retail (retail warehouse) type occupancies or use groups (occupancies consisting of open type floor plan utilizing rack storage type structures consisting of any combination of horizontal, vertical or diagonal members that support stored material or displayed material generally exceeding 12 feet in height), is it the intent of the code to classify such uses as *Mercantile*, Use Group *M*, based on the stock of goods for sale and accessibility to the public?

Answer: No. Due to the life and fire hazard as noted in Section 312, *Doubtful Use* Classification, this type of occupancy should be classified Doubtful Use Group until sufficient information is provided to the satisfaction of the Building Official in order that the Building Official can determine the appropriate use (or uses) which it most resembles in terms of life and fire hazard in accordance with section 312.

Regardless of the *Use Group* classifications determined by the Building Official, it is the responsibility of the permit applicant in accordance with section 113 (*Application for Permit*), to provide sufficient information to show the nature and character of the work. As part of this section, the Building Official shall forward the available information to the Head of the Fire Department for review and approval of the applicable sections of Article 6, Special Use and Occupancy Requirements and Article 10, Fire Protection Systems.

As addressed in Article 10, Section 1001.2, the information presented must be "... of sufficient detail to evaluate the hazard and the effectiveness of the system. The details of the hazards shall include materials involved, the location and arrangement, and the exposure to the hazard."

To properly address the particular issues and acquire the required information for such a review as identified in Section 1001.2, any plans, documents and reports which are submitted to the Building Official in accordance with sections 113 and 127 must bear the seal of a qualified professional engineer or architect when required by the building code or statute. Since Section 1001.2 addresses special fire protection features, it shall be noted that the Building Official and the Head of the Fire Department should refer to the official interpretation No. 38-94 Relating to the Use of Registered Professional Engineers Seal as required under Section 113.5.2 and 127, to determine whether the information submitted is sufficient and properly documented and sealed by engineers qualified in fire protection concerns. (see Official Interpretation No. 38-94)

Unless the necessary information and documentation is properly submitted in sufficient detail per Section 1001.2, the Head of the Fire Department will not be capable of proper evaluation and analysis of the hazards and exposures to property and life and any associated fire and life safety systems provided and therefore can not approve the plans. In order for the Head of the Fire Department to approve plans and specifications per Section 113.5(*Plans and Specifications*).

Sufficient details and supporting documentation should be included to address, as a minimum, the following;

- Material storage/display arrangement
- Segregation/separation of incompatible/hazardous materials
- Emergency evacuation plans (number and location of exits)
- Warehousing operations (open and closed)
- Employee training and drills
- Management participation (housekeeping)
- Fire initiation and development
- Spread of smoke and toxic products
- Smoke exhaust venting
- Fire Suppression Systems
- Standpipe systems ($2^{1/2}$" vs. $1^{1/2}$" outlets)
- Requirements for rack sprinklers (NFiPA 231C)
- Adequacy of water supplies
- Egress relative to rack aisles (blockage/obstructions)
- Occupant evacuation time
- Fire alarm systems (automatic and manual)
- Fire Department notification (master box/central station service)
- Occupant notification
- Fire Department site and building entry access
- Seasonal changes in merchandising (introduction of additional flammable and hazardous material)
- Access to floor/merchandising plan (periodic review)
- Review of other agency requirements (CMR 527, Fire Prevention Regulations)
- Review of other nationally recognized engineering standards relative to fire hazards and life safety

If sufficient client information is not provided to the Head of the Fire Department as identified above, then the Building Official shall classify the building as Doubtful Use Group per Section 312, *Doubtful Use* Classification, and the structure shall be included in the use group it most nearly resembles, (such as a Use Group *H*, *High Hazard* Uses, Section 306 or as described in Section 308, *Mercantile* Uses, Use Group *M*, or as the Building Official so deems until adequate information is provided as per Section 1001.2, to determine otherwise.

If sufficient information is submitted in detail satisfactory to the Building Official and the Head of the Fire Department to achieve the desired level of life safety and fire hazard protection, then the building could be classified Use Group *M* or other as determined by the Building Official in cooperation with the Head of the Fire Department.

Official Interpretation No. 45-96

DATE: June 27, 1996

SUBJECT: Impacts of M.G.L. c. 148, §§ 26G, 26H and 26I

At a regular meeting of the Board of Building Regulations and Standards held on Thursday 27, June 1996, the Board approved the following interpretation of the application of M.G.L. c. 148, § 26G, 26H and 26I as they impact the building permit process.

Discussion: M.G.L. c. 148, §§ 26G, 26H and 26I are "local option statutes". These are state laws which are not applicable in a municipality until a municipality elects to adopt them, at which time they become law in that municipality. The statutes are "Fire Safety Statutes", and require the installation of automatic sprinkler systems in specific buildings identified in the statutes. Once adopted, they are enforced by the Head of the Local Fire Department (the Fire Chief).

In summary, the statutes require the following

Statute (M.G.L.)[a]	Requirements	Appeal Provision
c. 148, § 26G[b]	Automatic Sprinkler System in: 1) New buildings over 7,500 sf 2) Additions to existing buildings (addition only) over 7,500 sf 3) Major alterations to existing buildings over 7,500 sf	Automatic Sprinkler Appeals Board
c. 148, § 26H	Automatic Sprinkler System in lodging and boarding houses	Automatic Sprinkler Appeals Board
c. 148, § 26I	Sprinkler system installation in; 1) New multiple family dwellings containing four or more dwelling units. 2) Substantially rehabilitated buildings in multi family dwellings containing four or more dwelling units.	State Fire Marshal

Notes:

(a) Refer to statute for exact wording

(b) Residential uses exempted

In some municipalities, the adoption of these statutes has created an apparent regulatory conflict and has, in extreme cases resulted in omission of sprinkler systems at the outset of construction resulting in lawsuits and court judgments requiring the installation of the sprinkler systems after occupancy. Needless to say, such cases have proved to be extremely costly.

Question: How do these particular statutes affect the responsibilities of the Building Official in the enforcement of the State Building Code? In particular, what action does the Building Official take at the building permit application stage?

Answer: In accordance with the provisions of *M.G.L. c. 143, § 3*, the Building Official is empowered to enforce the provisions of the State Building Code and the Architectural Access Board Regulations (521 CMR). The Fire Chief is empowered to enforce the provisions of *M.G.L. c. 148, §§ 26G, 26H and 26I.*

The statutes link the requirement to install the automatic sprinkler to the building code by requiring the installation to be "*....in accordance with the provisions of the state building code*" . This language shall be properly interpreted as "*....in accordance with standards referenced for the installation of an automatic sprinkler system*", e.g. NFiPA 13, 13R or 13D, etc. Such interpretation would also extend to the permitting requirements of Article 1.

The Building Official's approach in municipalities which have adopted said statutes shall be;

The Building Official should become generally aware of the requirements of *M.G.L. c. 148, §§ 26G, 26H and 26I.*

If a building permit application is made which may trigger the enforcement of the statutes, the determination is (by law) made by the Fire Chief. It is clear in the subject statutes that the Fire Chief is the sole authority to determine whether or not a particular construction activity is subject to said statutes and the municipality and its agents, including the Building Official are bound by this determination. The permit applicant is provided avenues of administrative appeal from the Fire Chief's determination, by way of the State Fire Marshal or the Automatic Sprinkler Appeals Board. Once a determination has been made by the Fire Chief that the statute is applicable, the Building Official must ensure, at the building permit application stage, that provision has been made for the design and installation of the automatic sprinkler system. If plans submitted at the building permit application stage do not include the sprinkler system, the application shall be denied based on non compliance with Section 113 of the Massachusetts State Building Code, i.e. incomplete plans and/or application materials.

If an appeal is taken, the Building Official, pending the outcome of the appeal, may issue a permit in part and shall, in writing, concurrently notify the Fire Chief and the permit applicant. Said notification must clearly identify the limits placed on the construction.

In communities which have adopted the provisions of M.G.L. c. 148, § 26H, a certificate of inspection, as required by Table 108 for a lodging or boarding house, shall not be issued if an automatic sprinkler system has not been installed within the time provided for by said statute, providing that the Building Official has been notified by the Fire Chief of the date of the adoption of said statute. If an appeal is pending a temporary certificate of inspection may be issued and renewed, each for periods not exceeding 30 days, pending the outcome of the appeal.

This interpretation is made to foster cooperation between building and fire officials in this particular area of law which has caused some confusion in the past.

Official Interpretation No. 46-96

DATE: June 27, 1996

SUBJECT: Handrails and Guardrails in One and Two Family Dwellings
Section 3401.11 of the Fifth Edition of the State Building Code

At a regular meeting of the Board of Building Regulations and Standards held on Thursday 27, June 1996, the Board approved the following interpretation of the application of Section 3401.11 of the Fifth Edition of the State Building Code.

> Section 3401.11 states that "*. . . Handrails having [a] minimum and maximum height of thirty (30) inches and 34 inches, respectively, measured vertically from the nosing of the treads shall be provided on at least one side of stairways of three or more risers. Open sides of all stairs shall be similarly protected by guards. . .* "

Question 1: Is it the intent of Section 3401.11 to require ***both*** handrails and guardrails set at different heights on the open sides of stairs in a one or two family dwelling?

Answer 1: No. It is the opinion of the Board that the word ***similarly*** refers to the handrail description, which means that the open side of the stair must be protected with a guardrail that also acts as a handrail. It is ***not*** necessary to provide a guardrail set at 36 inches in height with a handrail set between 30 and 34 inches.

Question 2: At what height should the guardrail be set?

Answer 2: The guardrail may be set between 30 and 34 inches in height measured vertically from the nosing of the tread. If a handrail is provided on the opposite side of the stair, it shall be set at the same height.

Official Interpretation No. 47-98

DATE: March 10, 1998

SUBJECT: Application of 780 CMR 3408.6.3 (2) and 2305.6.4 of the Sixth Edition of the State Building Code.

At a regular meeting of the Board of Building Regulations and Standards held on Tuesday 10, March, 1998, the Board approved the following interpretation of the application of 780 CMR 3408.6.3 (2) and 2305.6.4 of the Sixth Edition of the State Building Code.

Discussion: Chapter 34, See 780 CMR 3408.6.3(2), under certain conditions during the renovation of an existing building, requires masonry walls to be connected to floors and/or roofs in order to improve (or affect) lateral support of the walls.

> *All masonry walls shall be connected to floor or roof diaphragms, or other elements providing their lateral support, so as to conform to the requirements of 780 CMR 1612.7. The design force for the connection shall not be less than 100 pound per linear foot of wall. Connections shall not produce cross-grain bending in wood members.*

In existing buildings with wood framed floor and roof systems and masonry loadbearing walls, building codes have traditionally required (based on traditional construction methods) wood floor and roof members framing into masonry walls to be "fire cut".

2305.6.4: Fire Cuts: All wood and other combustible floor, roof and other structural members framing into masonry walls shall be cut to a bevel of three inches (76 mm) in depth and shall project not more than four inches (102 mm) into the wall.

Fire cuts are representative of traditional construction detailing methods stemming principally from older "mill" type buildings which, in the event of a fire resulting in the their collapse of a floor or roof are intended to allow the framing members to rotate at supports allowing the floors to collapse without causing the collapse of the wall systems.

Question: Does the seismic requirement for connection of masonry walls to floors override or negate the requirement to preserve existing fire cuts in wood structural members ?

Answer: No. The provision for fire cuts and lateral support of masonry walls serve different purposes and are independent requirements. Compliance with both code provisions is required.. The designer of the lateral support details requirement must exercise care in the detailing of such connections. The connections must be detailed to allow the framing members at the wall connection to rotate in the event of a fire while additionally providing the lateral support for the walls in the event of an earthquake.

Official Interpretation No. 48-98

DATE: March 10, 1998

SUBJECT: Application of 780 CMR 1012.6 and 101.6 of the Sixth Edition of the State Building Code.

At a regular meeting of the Board of Building Regulations and Standards held on Tuesday 10, March, 1998, the Board approved the following interpretation of the application of 780 CMR 1012.6 and 101.6 of the Sixth Edition of the State Building Code.

Discussion: 780 CMR 1012.6 of the Sixth edition of the Massachusetts State Building Code governs the requirements for assembly aisles and aisle accessways. 780 CMR 1012.6 specifically addresses the required width of an aisle accessway (row) and states;

780 CMR 1012.6: Row Widths: The minimum clear row width shall not be less than 12 inches (305 mm) measured as the clear horizontal distance from the back of the row ahead and the nearest projection of the row behind. Where chairs have automatic of self rising seats, the measurement shall be made with the seat in the raised position. Where any chair in the row does not have an automatic or self rising seat, the measurement shall be made with the seat in the down position. Where tablet arm seating is used the measurement shall be made with the tablet- arm in the useable position.

The state building code appendix A references the Life Safety Code NFPA 101 (1994), which, in section 8-2.5.7.6, states;

Rows of seating utilizing tablet-arm chairs shall be permitted only if the clear width of aisle accessways complies with the requirements of 8-2.5.7 where the tablet is in the useable position.

Exception: Tablet arms shall be permitted to be measured in the stored position where the tablet arm automatically returns to the stored position when raised manually to a vertical position in one motion and falls to the stored position by force of gravity.

Question: Is the life safety code section applicable? Can the exception in NFPA 101 8-2.5.7.6 be utilized ?

Answer: The State Building Code 780 CMR 101.6 explains under what circumstances referenced standards are applicable;

101.6 Referenced Standards: The standards referenced in 780 CMR and listed in Appendix A shall be considered part of the requirements of 780 CMR to the prescribed extent of each such reference. Where differences occur between the provisions of 780 CMR and referenced standards, the provisions of 780 CMR shall apply. . . .

Therefore the answer to the forgoing questions is in the negative, for the following reasons;

780 CMR 1012.6 provides no direct reference to NFPA 101 and therefore the provisions of NFPA 101 as they relate to the measurement of row widths are inapplicable. It is incorrect to assume that simply because NFPA 101 is referenced in 780 CMR that it is referenced in its entirety, and;

If NFPA 101 were referenced in the subject section, the provisions of NFPA 101, section 8-2.5.7.6 (exception) is in conflict with 780 CMR 1012.6 relative to the measurement of row widths where tablet-arm seating is present (780 CMR contains no such exemption for automatic return of tablets). In such instances 780 CMR 101.6 directs that the provisions of 780 CMR are applicable should a conflict occur between a provision of 780 CMR and a referenced standard.

In order to use this section of NFPA 101, an applicant must apply for and receive a variance from the State Building Code Appeals Board in accordance with 780 CMR 126.

Official Interpretation No. 49-98

DATE: March 23, 1998

SUBJECT: Smoke Detector and Heat Detector Requirements in One- and Two-Family Dwellings - 780 CMR 3603.16 of the Sixth Edition of the State Building Code.

At a regular meeting of the State Board of Building Regulations and Standards held on Tuesday, March 10, 1998, the Board approved the following interpretation of the application of 780 CMR Chapter 36, 780 CMR 3603.16, "FIRE PROTECTION SYSTEMS" of the Sixth Edition of the Massachusetts State Building Code.

Background/Discussion:

The Sixth Edition of the Massachusetts State Building Code (the Code), 780 CMR 3603.16 is titled: "FIRE PROTECTION SYSTEMS" and specifies all required fire protection system requirements for new construction one-and two-family dwellings that are single or two-family detached buildings; additionally, 780 CMR 3603.16.13 sets requirements for when smoke detector requirements for new construction will apply to additions, alterations and/or repairs.

The Sixth Edition One- and Two-Family fire protection system requirements, differ from those of the Fifth Edition Code in several ways.

The Sixth Edition reflects the philosophy of NFPA 72-1996[1], "National Fire Alarm Code" in that:

1. Household fire warning systems may consist of either ac primary powered single and multiple station smoke detectors complying with ANSI/UL 217, or;

2. Household fire warning systems (note that these household fire warning systems could be referred to as "a fire alarm panel with low voltage connection to detectors, etc."), may consist of a listed control unit complying with UL 864 or UL 985 with automatic smoke detectors complying with UL 268 and occupant notification appliances complying with UL 464 or UL 1971 if such notification appliances incorporate strobe lights - if supplementary visual signals are utilized they should comply with UL 1638, and;

3. All household fire warning systems shall have secondary power supplied from monitored batteries, and;

4. Massachusetts provisions require the use of photo electric smoke detectors, rather than the ionization type smoke detectors when such smoke detectors are on the same floor and within 20 feet of a kitchen or bathroom containing a tub or shower (to prevent nuisance false alarms characteristic of ionization type smoke detectors in proximity to kitchens and tub or shower areas), and;

5. Electrical compatibility (listed for intended purpose - see 780 CMR 3603.16.2) between smoke detectors and/or notification appliances to ensure that all portions of the household fire warning system will operate properly, and;

6. In addition to smoke detector requirements, the Sixth Edition of the Code has been structured to address heat detector requirements but at this time, and until 780 CMR 3603.16.4 is otherwise amended, HEAT DETECTORS ARE NOT REQUIRED IN ONE- AND TWO-FAMILY DWELLINGS, and;

7. 780 CMR 3603.16.8.1 addresses "non-required" alarm notification appliances and non-required smoke or heat detectors and requires that such are to be installed so that the actuation of any non-required detector shall cause the alarm in all required and non-required detectors in the dwelling unit to sound, and;

8. 780 CMR 3603.16.13 requires fire warning systems for new construction throughout an existing dwelling when one or more sleeping rooms are added or created in an existing dwelling.

Answers to some frequently asked questions about smoke detectors and heat detectors

Question 1: Are ionization type smoke detectors still allowed in new construction one- and two-family dwellings?

Answer 1: Yes, provided such smoke detectors satisfy the applicable general listing requirements of 780 CMR 3603.16 and are not located (on the same floor) within 20 feet of a kitchen or a bathroom containing a tub or shower (780 CMR 3603.16.11). Ionization smoke detectors that otherwise satisfy the general requirements of 780 CMR 3603.16 shall be allowed within 20 feet of a kitchen or bathroom containing a tub or shower when the ionization detector is on a different floor than the subject kitchen or bathroom.

Question 2: Would ionization smoke detectors be allowed in bedrooms when the bedrooms are separated from the kitchen or bath by both a bedroom door and a kitchen or bath door, even if such ionization smoke detectors are within 20 feet of a kitchen or bath door?

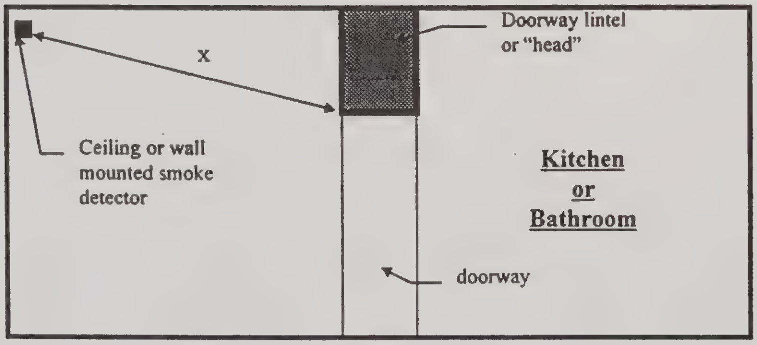
Answer 2: No. Once the smoke detector is within 20 feet of a kitchen or bath, then a photo-electric type smoke detector must be utilized.

Question 3: How does one measure the 20 foot distance from a kitchen or from a bathroom containing a tub or shower?

Answer 3: Refer to the sketches and note that the 20 foot rule applies to smoke detectors only on the same floor as kitchens or bathrooms containing a tub or shower and that the 20 foot distance from the smoke detector (ceiling or wall mounted) to the kitchen or bath shall be "true length", measured from:

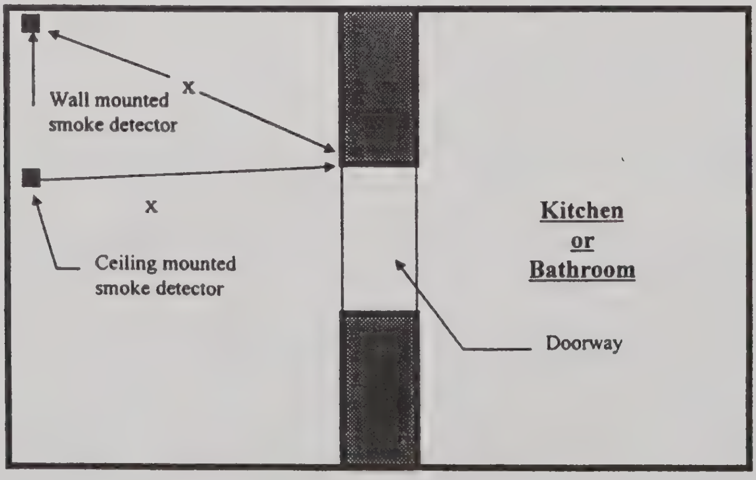
the centerline of the smoke detector to the nearest edge, front face of the doorway separating the kitchen or bath from the area in which the smoke detector is located (in "two room" layouts), and;

in "open plan" areas where no doorway separates the kitchen from the detector, the 20 foot rule shall be the shortest, "true length" 20 foot distance measured from centerline of ceiling-mounted or wall-mounted smoke detector to nearest edge of fixed smoke-producing appliance (stove, oven, broiler, etc.--note that movable appliances and/or microwave ovens are not to be considered relative to the 20 foot distance).



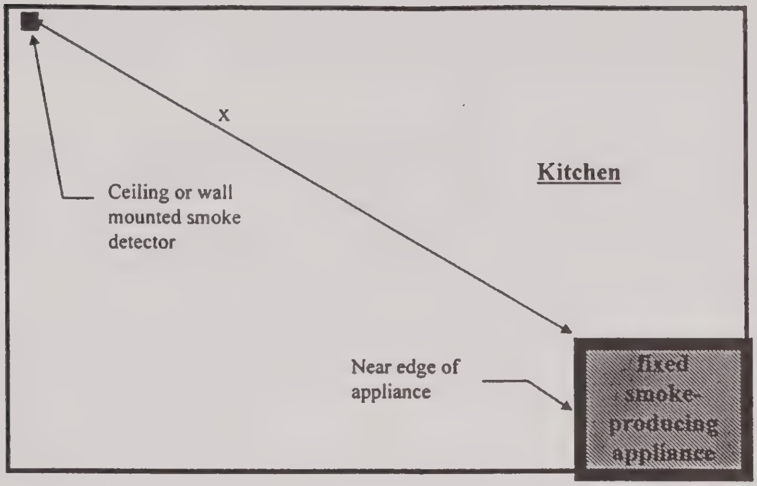
Section view of a "two room" layout with the ceiling-mounted or wall-mounted smoke detector (■) shown in the room on the left and the kitchen or bathroom represented by the room on the right.

If true length of "x" is less than or equal to 20 feet, then a photo electric smoke detector must be utilized. The true length of "x" is the actual distance from the centerline of the ceiling-mounted or wall-mounted smoke detector to the nearest edge of detector-side, front face of doorway.



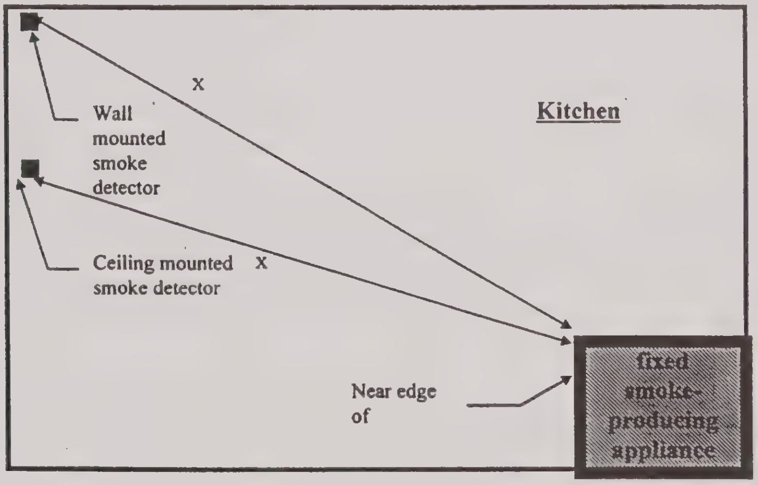
Plan view of a "two room" layout with either a ceiling-mounted or a wall-mounted smoke detector (■) shown in the room to the left and the kitchen or bathroom represented by the room on the right.

If true length of "x" is less than or equal to 20 feet, then a photo electric smoke detector must be utilized. The true length of "x" is the actual distance from the centerline of the ceiling-mounted or wall-mounted smoke detector to the nearest edge of detector-side, front face of doorway.


x
Kitchen
Ceiling or wall mounted smoke detector
Near edge of appliance
fixed smoke-producing appliance

Section view of an "open plan" layout with the ceiling-mounted or wall-mounted smoke detector (■) shown on the left and the kitchen represented to the right.

If true length of "x" is less than or equal to 20 feet, then a photo electric smoke detector must be utilized. The true length of "x" is the actual distance from the centerline of the ceiling-mounted or wall-mounted smoke detector to the nearest edge of fixed, smoke-producing appliance.


x
Kitchen
Wall mounted smoke detector
Ceiling mounted smoke detector
x
Near edge of
fixed smoke-producing appliance

Plan view of an "open plan" layout with the ceiling-mounted or wall-mounted smoke detector (■) shown on the left and the kitchen represented to the right.

If true length of "x" is less than or equal to 20 feet, then a photo electric smoke detector must be utilized. The true length of "x" is the actual distance from the centerline of the ceiling-mounted or wall-mounted smoke detector to the nearest edge of fixed, smoke-producing appliance.

Question 4: Are bedrooms now the only areas in which smoke detectors are required to be located?

Answer 4: No. 780 CMR 3603.16.10 defines all required smoke detector locations.

Question 5: 780 CMR 3603.16.7 titled "Secondary electric power" states that all household fire warning systems shall have secondary (standby) power supplied from monitored batteries in accordance with the household fire warning equipment requirements of NFPA 72. Does this mean that all smoke detector systems must have a battery room providing standby power?

Answer 5: No. Single and multiple station, hard-wired smoke detectors that are ac primary powered are now available with attached, replaceable battery and similar to battery-only single station smoke detectors, the battery is monitored via the detector circuitry.

For "alarm panel systems" (listed control unit with automatic detectors and occupant notification appliances), the monitored battery schemes tested and listed via the manufacturer's compliance to NFPA 72, suffice.

Question 6: 780 CMR 3603.16.10 (5) states that fixed temperature heat detectors shall be installed in accordance with the requirements of 780 CMR 3603.16.4. Does this mean that as of March 1, 1998, heat detectors are required in one- and two-family dwellings controlled by the requirements of 780 CMR Chapter 36 of the Sixth Edition of the Code?

Answer 6: No. As of March 1, 1998, heat detectors are still not required by 780 CMR Chapter 36 of the Sixth Edition of the Code as 780 CMR 3603.16.4 is currently "RESERVED" , thus, at this time and until 780 CMR 3603.16.4 is otherwise amended, heat detectors are not required by Chapter 36 of the Sixth Edition of the Code.

Question 7: 780 CMR 3603.16.13 requires that an existing one- or two-family dwelling be provided with a household fire warning system for new construction when one or more sleeping rooms are added or created in the existing dwelling. What constitutes a *bedroom* under this Section?

Answer 7: The State Board of Building Regulations and Standards (BBRS), as the Agency promulgating the Massachusetts State Building Code, is the "AUTHORITY HAVING JURISDICTION" (AHJ) regarding the interpretation of regulations of the State Building Code and has determined that it is the responsibility of the building owner or the agent of the building owner to identify any new or newly created *bedrooms or other space USES*. If submitted plans and/or narratives that describe the work intended identify such new additions or newly created spaces as other than *bedrooms* then 780 CMR 3603.16.13 does not apply (note that it is the "REGULATED COMMUNITY" and not the "REGULATOR" who identifies, on plans and/or narratives submitted as part of the building permit application to the Building Department, if a *bedroom* is being added or created).

[1] Note that although NFPA 72-1996 is titled the "National Fire Alarm Code", NFPA 72 is a national reference standard and where Massachusetts State Building Code regulations explicitly differ from the requirements set forth in the reference standard, the requirements of the State Building Code govern.

Official Interpretation No. 50-98

DATE: January 28, 1999

SUBJECT: Height and Area Requirements for Type 5B, One and Two-Family Dwellings as Defined by the Sixth Edition of the Code

Background:

A one- or two-family dwelling designed and constructed as an R-4 Use in accordance with the provisions of Chapter 36 of the Sixth Edition of the Code is typically built of Type 5B Construction. Chapter 36 does not define a one- or two- family structure in terms of its construction type. Referencing the definition section of this chapter, we learn only the number of lodgers and/or boarders legally allowed to occupy each dwelling, but do not learn much about the structure itself. However, the materials generally employed in one- and two-family dwelling construction most closely resemble those used in a Type 5B building as defined in Chapter 6 of the base code.

Also, Chapter 36 does not provide guidance in respect to the maximum size of a one-or two-family dwelling in terms of its height above grade (number of stories, and dimensional height) or in terms of its square foot area per floor.

Question: Absent this information, how does one determine the maximum size of a one and two-family dwelling building (both in terms of stories above grade and maximum square foot area per floor) if it is designed and constructed as an R-4 Use according to the provisions of Chapter 36?

Answer: Since Chapter 36 does not provide the answers we seek, we must first turn to Chapter 3, Section 310.6 which defines an R-4 structure as a "*detached one- or two-family dwelling(s) not more than* ***three stories*** *in height, and (its) accessory structures.*" This section states further that "*All such structures shall be designed in accordance with 780 CMR 36 (Chapter 36 of the Sixth Edition) or in accordance with the requirements of 780 CMR (this code) applicable to Use Group R-3*".

This section provides the code user with two distinct options for the design and construction of R-4 structures (detached one or two family dwellings and their accessory structures). Option 1; design in accordance with Chapter 36. Option 2; design in accordance with the requirements applicable to R-3 structures.

Question: Does this mean that such buildings may be designed and constructed with habitable floors **three stories** above the exterior grade plane?

Answer: Yes. However, one must assure that all applicable code requirements are satisfied for all inhabited floors including the upper-most floor (i.e.: light, ventilation, means of egress requirements, etc.).

At times, depending upon the configuration of the exterior grade, it may be difficult to determine the number of stories above which a building projects. Therefore, we have provided examples of buildings correctly configured under this definition. (See Figures 1a and 1b).

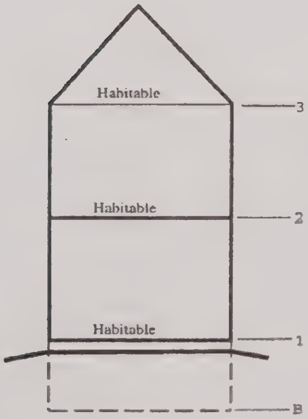


Figure 1a.

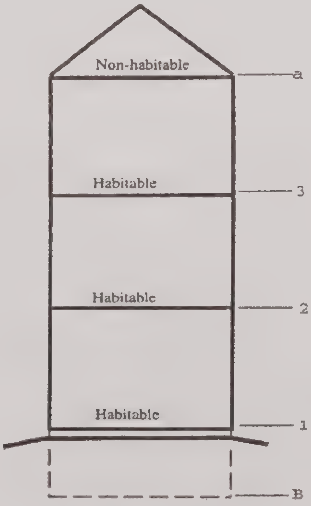


Figure 1b.

Note:	Figures 1a and 1b illustrate typical gable roof, single family dwellings. Figure 1a depicts a dwelling consisting of three floors of habitable space and a basement. Figure 1b shows a dwelling consisting of three floors of habitable space, a basement and attic space above the third floor. Assuming requirements set by local zoning ordinances are met, each structure as depicted satisfies building code requirements in terms of its allowable number of stories above grade. However, be cautioned that the attic area shown in Figure 1b shall only be used as storage (**not habitable or occupiable**) space.
Question:	Figure 1b illustrates a structure with attic space as the upper-most level. How does one distinguish habitable space from attic space?
Answer:	*Habitable space* is defined in Chapter 2 of the code as *"space in a structure for living, sleeping, eating, or cooking. Bathrooms, toilets compartments, closets, halls, storage or utility space and similar areas are not considered habitable space"*. *Attic* is defined in Chapter 12 as *"the space between the ceiling beams of the top story and the roof rafters"*. Attic space may only be provided if it does not constitute an additional story (i.e.: the head height and other conditions of this area do not allow for human occupancy. **Remember that by definition, the structure may only be three stories in height above the exterior grade plane.**
Question:	Since bathrooms are not considered habitable space, is it permissible to locate a bathroom in this attic level?
Answer:	No. The upper-most level, as illustrated in Figure 1b, is intended to be used as **storage** or **utility** space only and is limited by one or more construction features which fall short of that required for habitable or occupiable space (i.e.: ceiling height measures less than seven (7) feet, structural members will support only loads that are less than that required for habitable space, or room dimensions measure less than required, etc.).
Question:	What about an existing, two story home with attic space; may it be converted into a three story structure with each floor made habitable?
Answer:	Again, the key to this question is, does the attic comply with **all** applicable sections of Chapter 36 for habitable spaces (i.e.: design loads, light, ventilation, means of egress, etc.). If the answer is yes, then the structure may be converted. If portions of the third story do not satisfy code requirements (i.e.: the access stair is too narrow or rise and run dimensions are not satisfactory) the building official must reject the permit application. However, an applicant may seek relief through administrative appeal procedures (the Building Code Appeals Board) as defined in Chapter 1, Section 126, or offer compliance alternatives as defined in Chapter 34 of the code.
Question:	Is a walk-out basement defined as a story above grade, and is it considered to contribute to the height of the building?
Answer:	Chapter 5, Section 502.1 defines a story above grade as *"Any story having its finished floor surface entirely above grade except that a basement shall be considered as a story above grade where the finished surface of the floor above the basement is:* 1. *More than six feet (1829mm) above [the] grade plane;* 2. *More than six feet (1829 mm) above the finished ground level for more than 50% of the total building perimeter, or* 3. *More than 12 feet (3658mm) above the finished ground level at any point"*. As demonstrated by the definition above, the answer to this question is dependent upon exterior grade conditions; which makes sense. The code limits the number of stories above grade which a building may be constructed as a direct function of an occupant's ability to exit the building in the event of an emergency. The higher up in the building one resides, the farther one must travel to exit the building. In a fire condition, the code is concerned with smoke conditions in open stairwells and other factors that may limit one's ability to escape from a building. Consequently, a walk-out basement (or any basement meeting a part of the definition identified above) may very well contribute to the height of the building above grade, if it is constructed according to one of the methods defined above. Figures 2a through 2c illustrate conditions where a basement contributes to the number of stories above grade.

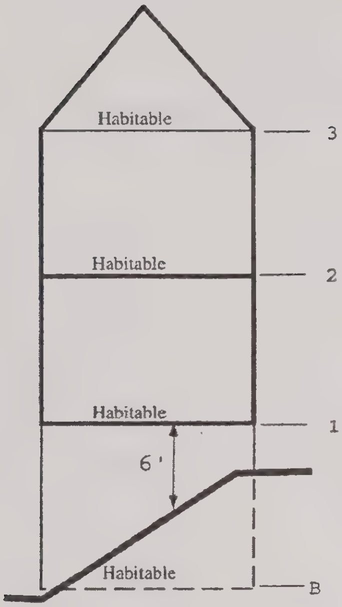


Figure 2a.

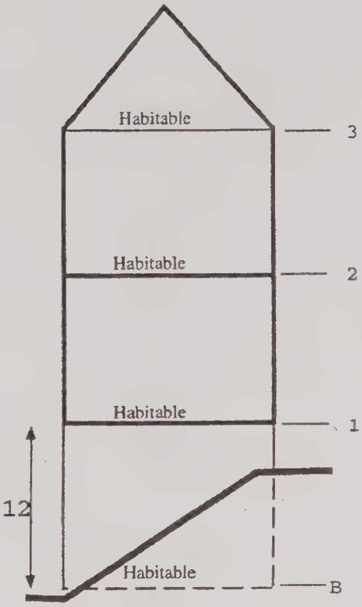


Figure2b.

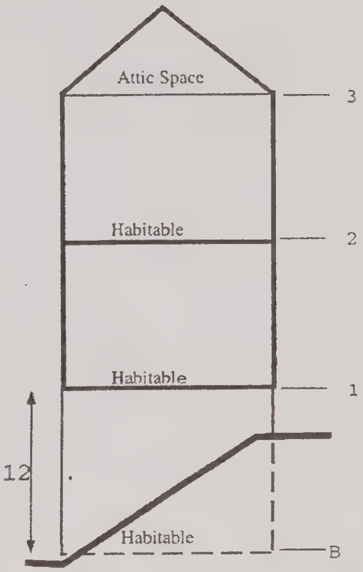


Figure2c.

Note: Both Figures 2a and 2b depict a single family dwelling which is **four stories** above grade (in reference to the definition for story above grade). Since the definition of an R-4 limits the building to **three stories** in height, these buildings (Figures 2a and 2b), erected of Type 5B construction, would be in violation of building code provisions. However, as is illustrated in Figure 2c, if the upper-most floor is designed and used as an attic (as defined in 780 CMR 202), it shall not be considered an additional story).

Question: To this point, only the height of the building has been addressed. What about the maximum area per floor for an R-4 structure?

Answer: Unlike the number of stories above grade, the code is silent on the issue of floor area for these structures. Essentially, the area is unlimited. This is not to imply that the code is not concerned with the size of the building in terms of its area, and that additional safeguards should not be considered in the design and construction of very large R-4 structures. However, these safeguards are built into the code in that very large buildings will be afforded additional smoke detection (see Chapter 36, Section 3603.16) and large structures are generally designed with egress capacity well in excess of what the code would normally require; usually with many exterior decks and balconies providing additional means of egress and/or routes of escape from the building.

Question: At the start of this interpretation, it was mentioned that Section 310.6 affords the code user two options when designing and building R-4 structures. We spoke of Chapter 36 requirements, but what about the option of designing the building as an R-3 using code provisions applicable to that use group?

Answer: It is clear that the code allows one to utilize this option. In doing so, however, one must recognize that different code requirements apply. Why? The Sixth Edition of 780 CMR is based on two separate national model codes; the 1993 BOCA National Building Code and the 1995 CABO One and Two Family Dwelling Code. As one might expect, uniting these two codes into a single document (as was done with the Sixth Edition of the Massachusetts State Code) sometimes results in conflicts between the two texts. The subject matter this interpretation illustrates one of these conflicts.

In explanation, R-3 structures are typically designed as multiple, single family, attached units (what are commonly referred to as row houses). Because these units are adjoined, the code is more concerned with conflagration and other safety issues, and therefore restricts the design of these structures more rigorously than it does for detached one and two-family dwellings.

We know that Chapter 36 is silent on height and area limitations for one and two family structures. Reviewing code provisions relative to R-3 structures, we find that 780 CMR Chapter 5, Table 503 defines height and area limitations for the R-3 Use Group Classification, but does not include reference to detached one and two-family buildings, as does the 1993 BOCA National Code. This reference was purposely deleted in the Massachusetts code to illustrate that the intended height limitations for detached one and two-family dwellings is to be three stories above grade as defined herein (and 780 CMR 310.6).

APPENDIX C

RECOMMENDED FASTENING SCHEDULE

Building element	Nail size and type	Number and location
Stud to sole plate	8d common 16d common	4 toe-nail or 2 direct-nail
Stud to cap plate	16d common	2 toe-nail or 2 direct-nail
Double studs	10d common	12" o.c. direct
Corner studs	16d common	24" o.c. direct
Sole plate to joist or blocking	16d common	16" o.c.
Double cap plate	10d common	16" o.c. direct
Cap plate laps	10d common	2 direct-nail
Ribbon strip, 6" or less	10d common	2 each direct bearing
Ribbon strip, 6" or more	10d common	3 each direct bearing
Roof rafter to plate	8d common	3 toe-nail
Roof rafter to ridge	16d common	2 toe-nail or direct nail
Jack rafter to hip	10d common 16d common	3 toe-nail or 2 direct-nail
Floor joists to studs (No ceiling joists)	10d common 10d common	5 direct or 3 direct
Floor joists to studs (With ceiling joists)	10d common	2 direct
Floor joists to sill or girder	3d common	3 toe-nail
Ledger strip	16d common	3 each direct
Ceiling joists to plate	16d common	3 toe-nail
Ceiling joists (laps over partition)	10d common	3 direct-nail
Ceiling joists (parallel to rafter)	10d common	3 direct
Collar beam	10d common	3 direct
Bridging to joists	8d common	2 each direct end
Diagonal brace (to stud & plate)	8d common	2 each direct bearing
Tail beams to headers (When nailing permitted)	20d common	1 each end 4 sq. ft. floor area
Header beams to trimmers	20d common	1 each end 8 sq. ft. floor area
1" roof decking	8d common	2 ea. direct rafter
(over 6" in width)	8d common	3 each direct rafter
1 " subflooring (6" or less)	8d common	2 each direct joist
1" subflooring (8" or more)	8d common	3 each direct joist
2" subflooring	16d common	2 each direct joist
1" wall sheathing (8" or less in width)	8d common	2 each direct stud
1" wall sheathing (over 8" in width)	8d common	3 each direct stud
Plywood roof & wall sheathing		
(½" or less)	6d common	6" o.c. direct edges & 12" o.c intermediate
(⅝" or greater)	8d common	6" o.c. direct edges & 12" o.c. intermediate
(5/16", ⅜",or ½")	16 gauge galvanized wire staples, ⅜" minimum crown; length of 1" plus plywood thickness	4" o.c. edges & 8" o.c. intermediate
(⅝")	Same as immediately above	2½" o.c. edges & 5" o.c. intermediate
Plywood subflooring:		
(½")	6d common or 6d annular or spiral thread	6" o.c. direct edges & 10" o.c. intermediate
(⅝", ¾")	8d common or 8d annular or spiral thread	6" o.c. direct edges & 10" o.c. intermediate
(1", 1⅛")	10d common or 8d ring shank or 8d annular or spiral thread	6" o.c. direct edges & 6" o.c. intermediate
(½")	16d galvanized wire staples	4" o.c. edges & 7" o.c. intermediate
(⅝")	⅜" minimum crown, 1⅝" length	2½" o.c. edge 4" o.c. intermediate
Built-up girders and beams	20d common	32" o.c. direct
Continuous header to stud	8d common	4 toe nail
Continuous header, two pieces	16d common	16" o.c. direct
½" fiber board sheathing	1½" galvanized roofing nail or 16 gauge staple, 1½" long with min. crown of 7/16"	3" o.c. exterior edge 6" o.c. intermediate

Building element	Nail size and type	Number and location
25/32" fiber board sheathing	1¾" galvanized roofing nail or 8d common nail or 16 gauge staple, 1½" long with min. crown of 7/16"	3" o.c. exterior edge 6" o.c. intermediate
Gypsum sheathing	12 gauge 1¾" large head corrosion-resistant	4" o.c. on edge 8" o.c. intermediate
Particle board underlayment (¼"-¾")	6d annular threaded	6" o.c. direct edges 10" o.c. intermediate
Particle board roof and wall sheathing ½" or less	6d common	6" o.c. direct edges 12" o.c. intermediate
⅝" or greater	8d common	6" o.c. direct edges 12" o.c. intermediate
Particle board subflooring (⅝" or greater)	8d common	6" o.c. direct edges 12" o.c. intermediate
Shingles, wood[a]	No. 14 B&S Gage corrosion resistive	2 each bearing
Weather boarding	8d corrosion	2 each bearing

Note a: Shingle nails shall penetrate not less than ¾" into nailing strips, sheathing or supporting construction except as otherwise provided in 780 CMR 1225.4.4.

Table C-1
Maximum Spacing of Gypsum Wallboard Fasteners
(For nonfireresistance rated construction assemblies)

Thickness of gypsum wallboard (inch)	Plane of framing surface	Long dimension of gypsum wall-board sheets in relation to direction of framing members	Maximum spacing of framing members (center-to-center in inches)	Maximum spacing of fasteners (center-to- center in inches)		Nails to wood
				Nails	Screws	
½	Horizontal	Either direction	16	7	12	No. 13 gage, 1⅜" long, 19/54" head No. 098 gage, 1¼" long, Annular ringed 5d cooler nail
	Horizontal	Perpendicular	24	7	12	
	Vertical	Either direction	24	8	12	
⅝	Horizontal	Either direction	16	7	12	No. 13 gage, 1⅝" long, 19/64" head No .098 gage, 1⅜" long, Annual ringed 6d cooler nail
	Horizontal	Perpendicular	24	7	12	
	Vertical	Either direction	24	8	12	
Fastening required with adhesive application						
½ or ⅝	Horizontal	Either direction	16	16	16	As required for ½" and ⅝" gypsum wallboard, see above
		Perpendicular	24	12	16	
	Vertical	Either direction	24			
2 layers each ⅜" (¾" total)	Horizontal	Perpendicular	24	16	16	Base ply nailed as required for ½" gypsum wallboard and face ply placed with adhesive
	Vertical	Either direction	24	24	24	

Notes to Table C-1:

Note a. Where the metal framing has a clinching design formed to receive the nails by two edges of metal, the nails shall be not less than ⅝ inch longer than the wallboard thickness, and shall have ringed shanks. Where the metal framing has a nailing groove formed to receive the nails, the nails shall have barbed shanks or be 5d cooler nail (No. 13 ½ gage, 1⅝ inches long, 15/64 inch head) for ½ inch gypsum wallboard; 6d cooler (No. 13 gage, 1⅞ inches long, 15/64 head) for ⅝-inch gypsum wallboard.

Note b. Two nails at 2 inches to 2½ inches apart may be used if the pairs are spaced 12 inches center-to-center except around perimeters.

Note c. Screws shall be No. 6 with tapered head and long enough to penetrate into wood framing not less than ⅝ inch and metal framing not less than ¼ inch

Note d. All nails shall meet ASTM C514 or Federal Specification FF-N-105C.

Note e. For fireresistance rated construction, see the pertinent fire test information.

Note f. 1 inch = 25.4 mm.

Table C-2
Allowable Shear for Wind or Seismic Forces in Pounds Per Foot For Vertical Diaphragms of Lath and Plaster or Gypsum Board Frame Wall Assemblies

Type of material	Thickness of Material	Wall Construction	Nail spacing maximum (in inches)	Shear value	Minimum nail size
Gypsum lath, plain or perforated	⅜" Lath and ½" Plaster	Unblocked	5	100	No. 13 gage, 1⅛" long, 19/64" head, plasterboard blued nail.
Gypsum sheathing board	½" x 2'x 8'	Unblocked	4	75	No. 11 gage, 1¼" long, 7/64" head,
	½"x4'	Blocked	7		diamond point, galvanized.
	½"x4'	Unblocked			
Gypsum Wallboard or Veneer base			7	175	5d Cooler nails
				100	
	1/2"	Unblocked	4		
		Blocked	7	100	
			4		
			4	125	
	5/8"	Blocked		150	6d cooler nails
		Two ply	Base ply 9		
				175	Base ply-6d cooler nails
			Face ply 7		
				250	Face ply-8d cooler nails

Note a. These vertical diaphragms shall not be used to resist loads imposed by masonry or concrete construction. Values are for short time loading due to wind or earthquake and must be reduced 25% for normal loading

Note b. Applies to nailing at all studs, top and bottom plates and blocking.

Note c. Values shown are for gypsum board applied to one side only. The shear values may be doubled when identical materials are applied to both sides of wall

Note d. 1 inch=25.4 mm.

NON-TEXT PAGE

APPENDIX D

GUIDANCE FOR SELECTION OF FOUNDATION MATERIAL CLASSES IN TABLE 1804.3

D-101.0 Purpose: The purpose of Appendix D is to provide guidance for the selection of the material class and consistency in place when using Table 1804.3.

D-102.0 Application: Appendix D is provided only as a general guide to engineering judgment. All available data should be evaluated and professional engineering judgment exercised in selection of the appropriate material classification for use with Table 1804.3. The references on soil and rock classification and typical ranges of index properties provided in this appendix should not be considered to be code requirements.

D-103.0 Classification of Soil: Guidelines for generally accepted engineering practice in the description and classification of soils are provided in ASTM D2488-84 Description and identification of Soils (Visual-Manual Procedure) and ASTM D2487-85 Classification of Soils for Engineering Purposes

D-104.0 Classification of Rock: Guidelines for generally accepted engineering practice in the description and classification of rocks are provided in Chapter 1 of Design Manual 7.1 - Soil Mechanics, Naval Facilities Engineering Command, May 1982 (NAVFAC DM-7.1)

D-105.0 Typical Index Properties: Typical ranges of index properties for the Material Classes listed in Table 1804.3 are provided in Table D-1.

TABLE D-1
TYPICAL RANGE OF INDEX PROPERTIES

Material Class	Description	Consistency in Place	Rock Quality Designation (RQD%)	Unconfined Compressive Strength (PSF)	Standard Penetration Resistance (Blows/Foot)
1a	Massive bedrock - granite, diorite, gabbro, basalt, gneiss,	Hard rock, minor jointing	>75	>8000	-
1b	quartzite, well-cemented conglomerate	Hard sound rock, moderate jointing	50 to 75		
2	Folliated bedrock	Medium hard rock minor jointing	>50	>8000	-
3	Sedimentary bedrock-cementation shale, silt-stone, sandstone, limestone, dolomite, conglomerate	Soft rock, moderate jointing	>50		-
4	Weakly cemented sedimentary bedrock - compaction shale or other similar rock in sound condition	Very soft rock	<50		
5	Weathered bedrock - any of the above except shale	Very soft rock. weathered and/or major jointing and fracturing	<50		-
6	Slightly cemented sand and/or gravel, glacial till (basal or lodgement), haropan	Very dense	-		>50
7	Gravel, widely graded sand and gravel, and granular abiation till	Very dense Dense Medium dense Loose Very loose	-		>50 41-50 16-40 8-15 <8
8	Sands and non-plastic silty sands with little or no gravel (except for Class 9 materials	Dense Medium dense Loose Very loose	-		>30 11-30 6-10 <6
9	Fine sand, silty sand and non-plastic inorganic silt	Dense Medium dense loose Very loose	-		>30 11-30 6-10 <6
10	Inorganic sandy or silty clay, clayey sand, clayey slit, clay or varved clay low to high plasticity	Hard Stiff Medium Soft	-		>20 9-20 4-8 <4

11	Organic soils - peat organic silt, organic clay	-	-		-

Notes to table D-1

Note 1: For discussion of RQD values see Deere, D.U., Rock Mechanics in Engineering Practice (Chapter 1), Stagg and Zinkiewicz, Eds., 1968, John Wiley and Sons, Inc.

Note 2: For determination of Unconfined Compressive Strength see ASTM D2938.

Note 3:For determination of Standard Penetration Resistance N-value see ASTM D1586. The presence of large particles (coarse gravel, cobbies, boulders) may cause N-values to be unrealistically high. Such values should not be used. Also standard penetration resistance should not be used over depths less than five feet.

APPENDIX E

PROCEDURE FOR ACCOUNTING FOR SERIES AND PARALLEL HEAT FLOW PATHS

E1: For envelope assemblies containing metal framing: The Ui shall be determined by using one of the following methods:

1. Results from laboratory or field test measurements. One of the procedures specified in 780 CMR 3108.2 shall be used.
2. The thermal resistance of those roof and wall assemblies listed in Tables E-1 and E-2 shall be corrected using the following procedures:

The total resistance of the heat flow path (Rt) is determined from the Equation E-1:

$$Rt = Ri + Re$$

Where:

R = 1/U

Rt = the total resistance of the envelope assembly.

Ri for: i = 1 to n, is the resistance of the series elements.

Re is the equivalent resistance of the element containing the parallel path, and the value of Re is:

Re = R value of insulation x Fc
(where Fc is the parallel path correction factor)

The Parallel Path correction Factors (Fc) may be obtained from tests conducted using procedures listing in 780 CMR 3108.2. Parallel Path Correction Factors for some envelope assemblies are listed in Tables E-1 and E-2.

Table E-1
ROOFS: PARALLEL PATH CORRECTION FACTORS[1]

Bridged R-Value	0	5	10	15	20	25	30	40	45	50	55
Correction Factor	1.0	0.96	0.92	0.88	0.85	0.79	0.76	0.73	0.71	0.69	0.67

Note 1. Table E-1 values are based upon: Metal trusses with 4-ft. spacing that penetrate the insulation, and 0.66 inch diameter crossmembers every one ft.

Table E-2
WALL SECTIONS WITH METAL STUDS: PARALLEL PATH CORRECTION FACTORS

Size of Members	Gauge of Stud	Spacing of Framing	Cavity Insulation R-Value	Correction Factor
2 x 4	18 - 16	16" o.c.	R-11	0.50
2 x 4	18 - 16	24" o.c.	R-11	0.60
2 x 6	18 - 16	16" o.c.	R-11	0.40
2 x 6	18 - 16	24" o.c.	R-11	0.45

Table E-3
CALCULATION PROCEDURES FOR EVALUATING ALL SERIES AND PARALLEL HEAT FLOW PATHS

		BRIDGE TYPE	
		Metal	Non-Metal
Type of Material to whuch bridge is attached	Metal	Thermal Bridges in Sheet Metal Construction Method	Parallel Path
	Non-Metal	Zone Method	Parallel Path

3. For elements with internal metallic structures bonded on one or both sides to a metal skin or covering, the "Thermal Bridges in Sheet Metal Construction," the calculation procedure as specified in "Thermal Bridges in Sheet Metal Construction," *Studies in Building Physics* (Johannesson, Gudni. 1981. Division of Building Technology, Lund Institute of Technology, Lund, Sweden. Report of TVBH-3007) shall be used.
4. For elements other than those covered above, the zone method described in Chapter 23 of the ASHRAE Handbook, 1985 Fundamentals Volume shall be used. The formulas on pages 23.13-.14 shall be used for calculation.

E2: For envelope assemblies containing Non-metal Framing, the Ui shall be determined from results from one of the laboratory or field test measurements specified in 780 CMR 3108.2 or from the ASHRAE series parallel method. Formulas in Chapter 23, page 23.2 of the ASHRAE Handbook, 1985 Fundamentals Volume shall be used for these calculations.

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APPENDIX F

REFERENCE DATA FOR REPAIR, ALTERATION, ADDITION AND CHANGE OF USE OF EXISTING BUILDINGS

PART ONE- GUIDELINES FOR APPLICATION

F-101 PURPOSE

F-101.1 Intent of 780 CMR 34: The purpose of Appendix F is to provide guidance to users of 780 CMR (the Massachusetts State Building Code) as to techniques of acceptable practice which can be used to assess the acceptability of various methods of meeting the intent of code provisions of 780 CMR 34 on a case-by-case basis. The purpose of the provisions in 780 CMR 34 and Appendix F is to allow the repair, alteration addition, and change of use of existing buildings without requiring the entire building to be brought up to new construction requirements, while still providing for the public health, safety and general welfare. The provisions of 780 CMR 34 and Appendix F recognize that the provisions of 780 CMR for new construction reflect the latest improvements in materials, construction techniques, standards of living and safety and, therefor, may preclude the repair, alteration, addition, or change of use of existing buildings that have demonstrated their usefulness and safety.

F-102.0 SCOPE

F-102.1 Techniques: Appendix F is intended to demonstrate techniques of analysis and compliance with 780 CMR 34 in the repair, alteration, addition, and change of use of existing buildings.

F-103.0

F-103.1 General conditions: Conceptually, it is the intent of 780 CMR 34 and Appendix F to allow repair, alteration, addition, or change of use of existing buildings without meeting all new construction requirements under the following general conditions:

1. all hazardous conditions must be corrected;
2. the existing building becomes the minimum performance standard; and
3. the degree of compliance of the building after changes must not be below that existing before the changes, except that nothing in 780 CMR 34 will require compliance with requirements more stringent than that required for new construction.

F-104.0 IMPLEMENTATION

F-104.1 Framework: Implementation of the above concept requires that a framework be established for evaluating the condition of the building; determining the potential for modification; and establishing the acceptability of proposed changes.

F-104.2 Evaluation of existing building: Evaluation of existing conditions in a structure is required to determine the existence of any hazardous conditions, which must be corrected; and to provide a basis for evaluating the impact of the proposed changes on the performance of the building.

The following list of evaluation tools described in Appendix F-104.1.1 through F-104.2.7 can be used for determining the condition of the structure. However, this list is not necessarily complete and the use of other methods should not be precluded.

F-104.2.1 Available documentation of existing building: Prime sources of design information for existing buildings are the architectural and engineering drawings and specifications used in the construction of the building. Although the passing of time often obscures depositaries of such documents, the following are likely prospects in attempting to locate such information:

1. If the building is currently in use, an individual or office responsible for its management may have retained drawings and specifications to facilitate maintenance. A building manager, resident engineer, superintendent, custodian, stationary engineer or plant engineer may be the most direct contact at the building site.
2. Other potential sources (especially if the building is not in use) include the original designer-architect or engineer.
3. The building department which issued the permit for construction may have documentation.
4. Documentation may have been retained by the general contractor or numerous subcontractors; i.e.: the mason, carpenter, plumber, electrician, HVAC installer, steel erector, etc., as well as manufacturers of component parts, as potential sources of documentation.
5. In the case of large corporations or government agencies, a separate contracting officer may have developed a technical file on the erection of a building.
6. In some cases, individual consultants are contracted to serve as "clerk-of-the-works" and pursue the inspection of a building project

from start to finish with the keeping of a file likely.
7. Insurance companies sometimes maintain drawings or records of their insured buildings.
8. Historical or archaeological societies may have considered a building to be important enough to develop a file of documentation.

F-104.2.2 Field surveys: Having drawn upon available documentation to help evaluate a building's condition, such documentation may be augmented by on-site data acquired through field survey. The most obvious approach is to make use of detailed visual examination to confirm and/or alter any previously available information pertaining to the building.

F-104.2.3 Testing: Testing is a tool that may be used in evaluating the condition of a building or structure or parts thereof when other methods of evaluation will not suffice. Testing may be initiated voluntarily on the part of the permit applicant or may be required by the building official in the absence of approved rules as indicated in 780 CMR 109.0, 116.0, and 34. The costs of all such tests are to be borne by the permit applicant and should, therefore, be required by the building official only when other methods of evaluation prove inadequate or insufficient. Such testing should be conducted by an approved testing agency under the supervision of a registered architect or engineer. The report of the tests shall be submitted to the building official and shall include the details of test procedures, references to any accepted test standards used, the results of the tests and any conclusions drawn from the test results.

F-104.2.4 Nondestructive testing: This includes techniques where the structural integrity of the building is not affected, such as the following:
1. analyzing various portions of the building to determine dimensions, types and condition of materials, etc.;
2. portable apparatus for impact testing;
3. load application short of failure to determine capacity of materials and components;
4. magnetic methods for detecting flaws in ferrous metal;
5. proximity magnetometers (locating rebars in concrete, concealed ferrous fasteners, etc.);
6. electronic means for measuring the sonic modulus of elasticity of concrete and masonry in assessing its soundness;
7. ultrasonic transmission or reflective methods in detecting flaws in various materials; and
8. x-ray or infrared-ray photographic techniques used to evaluate portions of elements whose integrity is questionable.

F-104.2.6 Destructive testing: In destructive testing a sample of the building could be removed and tested (e.g., concrete core), or components of the building could be reconstructed and tested in the laboratory.

F-104.2.7 Laboratory analysis: In some cases, tests can be performed in the laboratory. Such tests might include the following:
1. chemical or metallurgical test;
2. optical or electronic microscopic examination which can help identify and evaluate the soundness of materials where decay or other molecular degradation is involved;
3. conventional laboratory tests for determining physical properties (strength, ductility, absorption, solubility, permeability, stiffness, etc.; and/or
4. testing of a scale model of the building (computer model, wind tunnel model, etc.).

F-104.3 Evaluation of change in performance level: It is necessary to determine if the level of performance of the building after alteration is below that which existed before the change. The hazard level could be increased for certain attributes (such as fire safety) while decreased for other attributes (such as floor loads) for a given alteration. The evaluation of the change in hazard levels of each attribute can be accomplished using various tools singly or in combination as described below in Appendix F -104.3.1 through F-104.3.5.

F-104.3.1 Data on archaic systems: Performance data on architectural and structural systems encountered are tabulated in Appendix F, Part Four. This data can be compared to the proposed altered systems to determine if the performance is adversely affected.

F-104.3.2 Compliance alternatives: Alternate solutions tabulated in Appendix F, Part Two were developed from appeal data and from accepted practice. The list is not all-inclusive and should not preclude consideration of other alternatives.

F-104.3.3 Analysis methods: Analytical methods based on good engineering practice may be used to determine changes in performance levels.

F-104.3.4 Test methods: Test procedures as discussed in Appendix F-104.2.3 through F-104.2.6 can be used to evaluate the performance of existing construction.

F-104.3.5 Professional judgement: Professional judgement based on previous experience with similar buildings should be used to the fullest extent possible.

PART TWO- SUGGESTED COMPLIANCE ALTERNATIVES

F-201.0 PURPOSE AND SCOPE

F-201.1 Purpose: The purpose of Appendix F-201.0 is to assist the building official and those regulated by 780 CMR in judging the acceptability of compliance alternatives to specific provisions required by 780 CMR.

F-201.2 Application: Appendix F-201.0 contains generally acceptable compliance alternatives and examples. The examples are solely for the purpose of illustrating principles which can be applied to the solution of code compliance problems and are not necessarily acceptable under all circumstances. It is recognized that all building systems interact with each other. Therefore, any consideration of compliance alternatives must take into account all existing and proposed conditions to determine their acceptability. The principles applied can be used for the solution of similar compliance problems in other buildings and occupancy groups. Commentaries are provided where the philosophy in establishing the alternatives is not obvious. The examples were developed from appeal data and accepted practice. They are not all-inclusive and should not preclude consideration of other alternatives.

Note: It is anticipated that additional compliance alternatives will be added to Appendix F-201.0 through the mechanism of appeal decisions and from results of research being conducted by various organizations in the field of relative permanence of life safety systems.

F-202.0 COMPLIANCE ALTERNATIVES FOR EGRESS REQUIREMENTS

F-202.1 Number of exits:

F-202.1.1 General compliance alternatives:

1. Provide connecting fire balconies.
2. Provide alternate egress facilities (windows, etc.).
3. Provide a fire escape.
4. Provide fire-rated areas of refuge.

F-202.1.2 Examples:

Example 1 involves a five-story Building of Use Group B without a fire suppression system and with only one *means of egress*.

Solution A. Add one or more fire escapes as may be necessary to provide all tenants with reasonable access to two *means of egress* in separate directions. Access to a street, public way or area of refuge shall be provided at the termination of the fire escape.

Solution B. Add connecting fire balconies across fire walls if the above solution is impractical due to construction difficulties.

Example 2 involves a building of Use Group R-2 occupancy with an apartment in the basement. There is only one *means of egress* from the basement.

Solution A. Provide egress windows in each apartment that comply with 780 CMR 10.

F-202.2 Travel Distance:

F-202.2.1 General Compliance Alternatives:

1. Add detection system.
2. Add a partial fire suppression system.
3. Add smoke doors.
4. Increase fireresistance rating of corridor walls and doors.

F-202.2.2 Example: This example involves a four story building of Use Group R-2 without a fire suppression system. The length of exitway access travel is 150 feet.

Solution A. Add a partial fire suppression system off the domestic water supply (if adequate) in the exit access corridor.

Solution B. Subdivide corridor into segments, if less than 100 feet, with smoke doors.

Solution C. If not required by other sections of 780 CMR, install smoke and fire detectors with audible alarms in the corridor.

Solution D. Increase the fireresistance rating of the exit access corridor from one hour to two hours and provide "B" label self-closing or automatic closing fire doors in all openings into the corridor.

F-202.3 Enclosure of exitways:

F-202.3.1 General Compliance alternatives:

1. Improve enclosure of exitway.
2. Add a partial fire suppression system.
3. Add a detection system.

F-202.3.2 Examples: This example involves a four story row building of Use Group R-2 with connecting fire balconies and an interior stair. The stair is enclosed with lath and plaster, wood stud partitions and paneled doors.

Solution A. Cover partitions on the apartment side with ⅝" Type X gypsum wallboard or its equivalent. Replace or build up panel doors until minimum solid portion is 1⅜" and install self-closers.

Solution B. Provide a heat and smoke detection system in the stairwell with an alarm audible to all tenants. Provide self-closers on all stairwell doors.

Solution C. Provide a partial fire suppression system in the stairwell off the domestic water supply (if adequate). Provide self-closers on all stairwell doors.

F-202.3.3 Commentary: The above example, while pertaining to a four story, Use Group R-2 building, can also be applied to other buildings of occupancies and floor levels. The principle that the degree of code compliance may not be reduced should be remembered. If the existing enclosure is of fireresistive construction, it must be maintained. The primary principle to remember, in the required enclosure of exitway, is that an enclosure must be provided, whether fireresistive or not, so as to provide a smoke barrier. The purpose of providing a smoke barrier is to prevent the passage of smoke from a fire on one floor to the exitways and exit access corridors of other floors and thus render them unusable for egress. This principle is illustrated by solutions A, B, and C in the above example.

F-203.0 COMPLIANCE ALTERNATIVES FOR FIRE HAZARDS

F-203.1 Fire separations and partitions;

F-203.1.1 General compliance alternatives:

1. Improve fire separation.
2. Add a fire suppression system.
3. Add a detection system.

F-203.1.2 Examples: **Example 1** involves a three story building of Type 3A construction, containing a Mercantile (M) Use Group, on the first floor and occupancy Business (B) Use on the second and third floors. The required separation is three hours.

Solution A. Add a fire suppression system to the first and second floors.

Solution B. Add ⅝ inch Type X gypsum wallboard or its equivalent to the underside of the second floor and install a system of smoke and heat detectors with audible alarms on the first and second floors.

Example 2 involves the separation between two tenants of wood lath and plaster on a wood studs partition. The required separation is one hour.

Solution A. Add ⅝ inch Type X gypsum wallboard or its equivalent to either side of the existing partition.

Example 3 involves a building of Use Group B with unrated exit access corridors.

Solution A. Install a partial fire suppression system in the exit access corridors.

Solution B. Add ⅝ inch Type X gypsum wallboard or its equivalent to either side of the corridor partition and install self-closers on all corridor doors.

Solution C. Install a smoke and heat detection system in the corridor with and alarm audible to all tenants on the floor and install self-closers on all corridor doors.

F-203.2 Openings and exterior wall protection:

F-203.2.1 General compliance alternatives:

1. Add fire suppression system.
2. Improve fireresistance.
3. Remove or improve openings.

F-203.2.2 Examples: **Example 1** involves a two story of Type 5B construction building, with Use Group M, on the first floor the basement and upper floors. The distance between the building and the side lot line is five feet and ten feet between it and the adjacent building. The adjacent building is of Type 5B construction and Use Group R-2. The former occupant was a grocery store; the new occupant is a hardware store.

Solution A. Install a deluge sprinkler system along the interior side of the wall affected.

Solution B. Add ⅝ inch Type X gypsum wallboard to interior side of the wall affected.

Example 2 is the same as example 1 but with double-hung wood windows in affected wall.

Solution A. Remove windows and close opening with one hour fireresistive construction.

Solution B. Remove windows and install fire windows.

Solution C. Install a deluge sprinkler system as in solution A to example 1.

PART THREE- DETAILED CLASSIFICATION OF OCCUPANCY BY HAZARD INDEX NUMBER AND USE GROUP

Appendix F, Part Three provides a more detailed guide for users of 780 CMR to determine hazard index numbers and use groups for various types of occupancies. It supplements 780 CMR 3 and Table 34 contained in 780 CMR 3404.

TABLE F-1
HAZARD INDEX AND USE GROUP CLASSIFICATION

Use of Structure	Hazard Index No.	Use Group
Advertising Displays Manufacture including billboards	3	S-1
Airport or other aircraft landing or service facility (see also: Helicopter rooftop landing facility	3	F
Amusement park, indoor	4	A-3
Animal		
Crematorium	3	F-2
Hospital, kennel, pound	2	B
Apartment (see Residences)		
Appliances		
Manufacture	3	F-1
Sales	3	M
Arenas	4	A-3
Asphalt		
Processing and products manufacture	8	H
Athletic equipment		
Manufacture	3	F-1
Sales	3	M
Auditoriums	6	A-1 with stage
	5	A-1 without stage
	4	A-3
Automobile and other motor vehicles		
Gasoline service station	3	M
Rental agency within a building	2	B
Repair	3	S-1
Repair incidental to auto sales with limitation	3	S-1
Sales within a building	3	M
Wrecking	3	F
Washing	3	S-1
Awning manufacturer	3	F-1
Baked goods shop	3	M
Bakeries	3	F-1
Banks	2	B
Banquet halls	5	A-3
Barber shops	2	B
Beauty shops	2	B
Beverages	2	
Bottling		F-1
Manufacture		
Alcoholic	8	H
Less than 0.5% alcohol @ 60°	3	F-1
Bicycle		
Manufacture	3	F-1
Rental or repair conducted within a building	3	S-1
Sales	3	M
Billiard Parlor	4	A-3
Blacksmith shops	3	F-1
Blueprinting, etc. establishments	3	F-1
Boarding house	2	R-1 or R-2
Boats or ships		
Building or repair of boats	3	F-1
Bone distillation	3	F-1
Bowling alleys	4	A-3
Broom or brush manufacture	3	F-1
Building materials		
Wholesale business in roofed structures	3	M or S-1
Bus terminals or stations	4	A-3
Business schools or colleges	4,2 or other	A-4, B or dependent upon use
Camera and other photo equipment		
Manufacture except film sales	3	M
Sales	3	M

TABLE F-1 (continued)
HAZARD INDEX AND USE GROUP CLASSIFICATION

Use of Structure	Hazard Index No.	Use Group
Canvas or canvas products		
Manufacture or repair	3	F-1
Carpet and rug		
Cleaning establishments	8 or 3	H, F-1
Manufacture or repair	3	F-1
Catering for outside consumption	3	F-1
Cemeteries		
Crematory in cemetery	3	F-2
Mausoleum, crypt, columbarium	1	S-2
Mortuary chapel in cemetery	4	A-4
Ceramics products manufacture, including pottery, small glazed tile and similar items	3	F-2
Charcoal, fuel, briquettes, or lampblack manufacture	8	H
Chemicals		
Packaging	8 or 3	H or F-1 depending on nature of material
Manufacture	8 or 3	H or F-1 depending on nature of material
Churches or other places of worship	4	A-4
Circuses, temporary	4	A-3
Cleaning (see Drycleaning & dying; Laundries; Automobiles, washing)		
Clothing		
Manufacture	8 or 3	H or F-1 depending on nature of material
Rental establishment		
Retail sales	3	M
Tailoring, custom manufacture or repair (see also Feathers; Felt; Fur;	3	M
Leather)	3	M
Clubs		
Private		
Nightclubs (see Eating & drinking establishments)	4	A-3 without residence
Coal, coke or tar products		
Manufacture	8	H
Colleges and Universities		
Classroom buildings	4	A-3
Dormitories	2	R-2
Fraternities or sororities	2	R-2
Community centers	4 or 2	A-3, or B
Convalescent homes (see Nursing homes)		
Convents	2	R-2
Cosmetics or toiletries manufacture	8	H
Cotton ginning	8	H
Cotton wadding or linters manufacture	8	H
Courthouses	2 or 4	B or A-3
Crematoriums		
Animal	3	F-2
Human	3	F-2
Dance halls	7	A-2
Day care agencies	4	I-2 or E
Day nurseries	4	I-2
Dental offices (see Medical & dental)		
Department stores	3	M
Dormitories	2	R-1 or R-2
Dressmaking shops, custom	8	H
Drinking places (see Eating & drinking establishments)		
Drive-in restaurants	5	A-3
Drug stores	3	M
Dry cleaning and dying establishments	8 or 3	H or F-1 depending on solvents used
Dwellings (see Residences)		

TABLE F-1 (continued)
HAZARD INDEX AND USE GROUP CLASSIFICATION

Use of Structure	Hazard Index No.	Use Group
Eating or drinking establishments		
Lunchrooms, restaurants, cafeterias, etc., primarily enclosed	5	A-3
Drive-in	4	A-3
With entertainment or dancing	7	A-2
Electric		
Power or steam generating plants	3	F-1
Substation	3	F-1
Electrical appliances, bulbs, wiring, supplies, etc.		
Manufacture	3	F-1
Sales	3	M
Electronic components & supplies		
Manufacture or repair	3	F-1
Feathers		
Curing, dyeing, washing or bulk processing	8	H
Manufacturing exclusive of above	8	H
Felt		
Curing, dyeing, washing or bulk processing	3	F-1
Products manufacture, exclusive of above	3	F-1
Fertilizer manufacture	8	H
Film, photographic, manufacture	3 or 8	F-1 or H
Storage and studios	3 or 8	F-1 or H
Fire stations	2	B
Fish processing	3	F-1
Florida shops	3	M
Food		
Product processing except meat & fish	3	F-1
Retail sales	3	M
Fraternities or sororities	2	R-1 or R-2
Funeral establishments	4	A-3
Fur		
Curing, dyeing, finishing, tanning	8	H
Products manufacture exclusive of above	3	F-1
Garage (see Parking garage)		
Garbage incineration or reduction	3	F-1
Gas		
Manufacture	8	H
Public utility stations for metering or regulating	2	B
Storage		
2500 cu. ft. or less	3	S-1
more than 2500 cu. ft.	8	H
Gasoline service station (see Automobiles)		
Gelatin manufacture	3	F-1
Generating plants, electric or steam	3	
Gift shops	3	M
Glass products from previously manufactured	3	F-2
Glue manufacture	3	F-1
Golf		
Indoor courses or driving ranges	4	A-3
Gymnasiums	4	A-3
Grain storage	8	H
Hair		
Curing, dyeing, washing, bulk processing	3	F-1
Product manufacture exclusive of above	3	F-1
Hardware		
Manufacture	3	F-1
Retail sales	3	M
Hat bodies manufacture	3	F-1
Helicopter landing facility, rooftop	3	S-1
Home occupations	2	B
Homes for the aged	4	I-2
Hosiery manufacture	3	F-1

TABLE F-1 (continued)
HAZARD INDEX AND USE GROUP CLASSIFICATION

Use of Structure	Hazard Index No.	Use Group
Hospitals		
Including convalescent, nursing, or rest homes and sanitariums, provided custodial care is not provided for drug addicts, alcoholics, mentally ill or mentally deficient	4	I-2
For care of drug addicts, mentally ill, or mentally deficient	5	I-3
Research or teaching laboratories (see also Animal hospitals)	2	B
Hotels	2	R-1
Ice manufacturing (dry or natural)	3	F-2
Ice skating rinks	4	A-3
Incineration or reduction of garbage, offal, or dead animals	3	F-1
Industry uses (see specific items)		
Without resulting noise, vibration, special danger, hazard, dust, smoke, fumes, etc.	3	F-2
Other than above	3 or 8	F-1 or H
Ink or inked ribbon manufacture	3	F-1
Jewelry	3	F-1
Kennels (see Animal)		
Laboratories		
Research laboratory not accessory to school or hospital	2	B
Scientific research or teaching laboratory, non-profit, accessory to school, or hospital, subject to limitations	2	B
Laundries		
Hand laundry		
Self service; pick-up and delivery station of laundry or dry cleaner	2	B
Steam laundries without limitations	3	F-1
Leather		
Curing, dyeing, finishing or tanning	3	F-1
Product manufacture exclusive of above	3	F-1
Libraries	4	A-3
Linoleum or oilcloth manufacture	3	F-1
Liquor sales, package	3	M
Luggage manufacture	3	F-1
Lumber (see Wood)		
Manufacturing	3 or 8	F-1 or H
Matches manufacture	8	H
Mattress manufacture and renovation	3	F-1
Meat Markets	3	M
Slaughtering or packaging	3	F-1
Medical & dental offices (see also Laboratories; Orthopedic & medical appliances; Hospitals)	2	B
Meeting hall	4	A-3
Metals, manufacture	3	F-2
Reduction, refining or smelting	8	H
Monasteries	2	R2
Motels	2	R-1
Motor freight stations (see trucking terminals)		
Museums		
Musical instruments manufacture	3	F-1
Newspaper publishing	3	F-1
Newsstands	3	M
Novelty products manufacture	3	F-1
Nursing Homes	4	I-2
Offices	2	B
Oilcloth manufacture	3	F-1
Optical equipment or similar precision instruments manufacture	3	F-1
Orphanages	3	I-2
Orthopedic or medical appliance manufacture	3	F-1
Paint, turpentine or varnish		
Manufacture	8	H
Spraying booths	8	H

TABLE F-1 (continued)
HAZARD INDEX AND USE GROUP CLASSIFICATION

Use of Structure	Hazard Index No.	Use Group
Paper products manufacture	3	F-1
Parish houses	4	A-3
Parking garages		
Group 1	3	S-1
Group 2	1	S-2
Petroleum or petroleum products		
Refining	8	H
Storage	3	S-1
Pharmaceutical products manufacture	3	F-1
Photography studio	2	B
Plastics		
Product manufacture	8	H
Raw, manufacture	8	H
Police stations	2	B
Pool rooms	4	A-3
Post offices	2	B
Printing		
Plant	3	F-1
Printing or newspaper publishing	3	F-1
Prisons & other correctional or detention institutions	5	I-3
Pumping station or substation, water or sewage	3	F-2
Radio	3	
Sales	5	M
Studios with audience	2	A-1-B
Studios without audience		B
Railroad		
Freight terminal	4	A-3
Passenger station	3	S-1
Recreation		
Center, indoor	4	A-3
Community center building	4	A-3
Rectories	2	R-2
Residences		
One-family	2	R-3, or R-4
Two-family	2	R-3, or R-4
Apartment	2	R-2
Temporary dwelling structure	2	R-3
Boarding or lodging house	2	R-1 or R-2
Dormitory	2	R-1 or R-2
Fraternity or sorority	2	R-1 or R-2
Hotel, motel apartment with accessory services	2	R-1
Convents, monasteries, rectories	2	R-2
Research laboratories (see Laboratories)		
Restaurant, lunch room, cafeteria or other establishments primarily for eating	5	A-3
Retail business	3	M
Stores with combustible or flammable goods constructing a high hazard	8	H
Rubber		
Manufacture (natural or synthetic), including tires, tubes, or similar products	8	H
Products (exclusive or processing) including washers, gloves, footwear bathing caps and the like	3	F-1
Sanatariums		
Not providing custodial care for drug addicts, alcoholics, mentally ill, or mentally deficient	4	I-2
Providing care for the above	5	I-3
Schools	4	E
Seminaries	4 or 2	A-4 & R-1
Settlement houses (depending on nature of activities)	4 or 2	A-3 or B
Sewage		
Disposal plant	3	F-1
Pumping station	3	F-1 or F-2
Shoddy manufacture	8	H

TABLE F-1 (continued)
HAZARD INDEX AND USE GROUP CLASSIFICATION

Use of Structure	Hazard Index No.	Use Group
Shoes		
Manufacture	3	F-1
Repair shop	2	B
Silverware manufacture, plate or sterling	3	F-1
Size manufacture	3	A-3
Skating rinks	4	A-3
Soap and detergents		
Manufacturing, including fat rendering	8	H
Packaging	3	F-1
Solvent extracting	8	H
Sporting or athletic goods		
Manufacture	3	F-1
Stores	3	M
Stables	3	S-1
Stadiums	4	A-5
Wholesale business, including accessory storage other than flammable liquids, gases and explosives, in roofed structures	3 or 1	S-1 or S-2 depending on nature of materials
Stores (see Retail stores; or specific items)		
Tailor shops, custom	2	B
Tanning (see leather; Fur)		
Taxidermist shops	3	M
Telephone exchanges		
Automatic	2	B
Non-automatic	2	B
Television		
Sales	3	M
Studios	3	M
	6	A-1 with scenery
	5	A-1 np scenery
	2	B no audience
Textiles		
Manufacture, including knit & yard goods, thread or cordage, spinning, weaving, dyeing & printing, shoddy manufacture	3	F-1
Theaters	6	A-1 with scenery
	5	A-1 no scenery, motion picture
Tires, manufacture	8	H
Tobacco products manufacture including curing	3	F-1
Tools & hardware		
Manufacture	3	F-1
Sales	3	M
Toys		
Manufacture	3	F-1
Trailer park (see Mobile homes)		
Truck		
Repairs	3	S-1
Sales	3	M
Trucking terminals	3	S-1
Turpentine manufacture	8	H
Warehouses	8, 3, or 1	H, S-1, or S-2 depending on nature of materials
Waterpumping stations	2	F-2
Wax products manufacture	8	H

PART FOUR- ARCHAIC CONSTRUCTION SYSTEMS

F-401.0 PURPOSE AND SCOPE

F-401.1 Purpose: The purpose of of Appendix F, Part Four is to assist the building official and those regulated by780 CMR in evaluating the properties of archaic construction systems.

F-401.2 Scope: Appendix F, Part Four contains data on construction systems no longer in general use but which may be encountered in older existing buildings. It is meant to be used for assessing existing conditions when evaluating how proposed changes will impact upon the performance of the building.

F-401.3 Application: In any given problem, all available data should be collected and professional judgement exercised in arriving at decisions. Evaluative judgment should be used when test data does not exist or when applying the data contained in this standard.

F-402.0 ARCHAIC FIRERESISTIVE SYSTEMS

F-402.1 General: Appendix F, Part Four contains a list of fireresistive materials and construction which are not necessarily currently in common use. Some of the hourly ratings contained in the listing predate ASTM E-119 that is in current use. The hourly ratings may be higher or lower if tested according to ASTM E 119. In addition to the data contained herein, see Report BMS92, Building Materials and Structures, dated October 7, 1942, National Bureau of Standards. The data listed below is extracted from the Boston Building Code, circa 1943.

F-402.2 Fireresistive materials and construction:

F-402.2.1 Minimum qualities: Materials, to be given the fireresistive ratings specified in this part, shall have the following minimum qualities set forth in Appendix F F-402.2.2 through F-402.2.19.

F-402.2.2 Class 1 concrete: Concrete of Class 1 shall be so proportioned as to have a strength of at least 1500 pounds per square inch (psi) and the coarse aggregate shall consist of limestone, trap rock, blast furnace slag, cinders containing not more that 20% of combustive material, burned clay or shale.

F-402.2.3 Class 2 concrete: Concrete of Class 2 shall be so proportioned as to have a strength of at least 1500 pounds psi, the coarse aggregate consisting of sandstone, granite, quartzite, siliceous gravel or other similar material not over one inch in size.

F-402.2.4 Masonry: Masonry shall be laid in lime-cement or cement mortar, or approved masonry cement mortar, except that masonry of gypsum tile shall, and masonry of structural clay tile may, be laid in gypsum mortar. Masonry shall be thoroughly bonded by breaking joints in successive courses or by the use of metal ties.

F-402.2.5 Brick: Brick shall be burned clay or shale, concrete or sand-lime brick of Grade C or better.

F-402.2.6 Stone: Stone shall be limestone, marble, slate or equally fireresistive natural stone. Sandstone, granite or other stone which, because of its crystalline structure or for other reason, is less fireresistive, shall not be considered fire protection for structural metal, but may be used in a masonry wall not less that 12 inches thick required to have fireresistance. Stone masonry shall have the same fireresistive rating as brick masonry.

F-402.2.7 Cast stone: Cast stone masonry shall have the same fireresistive rating as brick masonry.

F-402.2.8 Concrete blocks: Concrete blocks, whether solid or hollow, shall have as coarse aggregate limestone, trap rock, blast furnace slag, cinders containing not more than 20% of combustible material, burned clay or shale.

F-402.2.9 Structural clay tile: Structural clay tile shall conform to the specifications for load-bearing tile, floor tile or partition tile. Where partition tile is specified load-bearing tile may be used.

F-402.2.10 Gypsum: Gypsum tile or pre-cast gypsum concrete, whether solid or hollow, shall conform to Standard Specifications for Gypsum Partition Tile or Block of the American Society for Testing Materials and shall not contain more than 3% by weight of wood or other combustible binder or filler.

F-402.2.11 Gypsum concrete: Gypsum concrete shall not contain more than 12½ by weight of wood or other combustive binder or filler and shall have a compressive strength of at least 500 psi. It shall not be used where exposed to the elements.

F-402.2.12 Lath: Expanded metal or wire lath as a base or reinforcement for plastering shall weigh not less that 2.2 pounds per square yard and shall have not less than 2½ meshes per inch.

F-402.2.13 Metal mesh for masonry: Metal mesh reinforcement specified for masonry fire protection of structural metal shall consist of wire lath strips the full thickness of the masonry, laid in the beds thereof, or its approved equivalent.

F-402.14 Metal mesh for concrete: Metal mesh reinforcement specified for concrete fire protection of structural metal shall consist of wire mesh weighing not less than 1½ pounds per square yard with wire spaced not over four inches, or not less than No. 11 gauge steel wire spaced not over four inches apart, or its approved equivalent.

F-402.2.15 Cement plaster: Cement plaster shall be proportioned of one part Portland cement, and not more than two parts of sand measured by volume dry and loose to which may be added lime putty or hydrated lime not exceeding 15% of the cement.

F-402.2.16 Gypsum plaster: Gypsum plaster, except where otherwise specified, may contain sand, not in excess of three times the weight of the gypsum.

F-402.2.17 Lime plaster: Lime plaster shall consist of a mixture of one part lime, not over three parts sand, and water.

F-402.2.18 Pneumatically projected mortar: Pneumatically projected mortar made of Portland cement, sand nd water shall be rated for fire protection the same as Class 1 concrete.

F-402.2.19 Concrete fill: Concrete fill, where specified in this appendix in connection with hollow masonry units shall consist of Class 1 or Class 2 concrete poured in the hollow spaces of the units as they are laid.

F-402.2.20 Reinforced concrete: Portland cement concrete or gypsum concrete poured in place as fire protection for beams, trusses and other horizontal or inclined members of structural steel and pneumatically projected mortar applied to structural steel as fire protection shall be reinforced with metal mesh reinforcement. Concrete protection for vertical columns of structural metal shall have reinforcing consisting of No. 5 wire spaced not over eight inches apart or its equivalent. Reinforcement shall be wrapped around the structural member and so arranged as to be completely embedded in the fire protection material and to ensure its integrity.

F-402.2.21 Reinforced plaster: Plaster used as fire protection or to resist the spread of fire shall be reinforced with metal lath, except plaster less than one inch thick or masonry or concrete.

F-402.2.22 Replacement material: In the protection of structural metal including reinforcement, ½ inch of cement or gypsum plaster may replace an equal thickness of poured concrete or pneumatically projected mortar as protective material; and one inch of cement or gypsum plaster reinforced with metal lath may replace an equal thickness of poured concrete, pneumatically projected mortar or masonry protection.

F-402.2.23 Plaster: Where plaster is required without other specification, it shall consist of ½ inch of cement or gypsum plaster, except that only gypsum plaster shall be used on gypsum masonry.

F-402.2.24 Thickness: In this appendix, except where otherwise specifically stated, the thickness given in a list of materials applies to the next following item only, and not to the total thickness where additional materials are specified.

F-402.2.25 Embedding limitations: Pipes, wires, conduits and ducts shall not be embedded in or placed behind the fire-protective materials required for the protection of structural steel or iron except as otherwise provided in this paragraph. Above fire-protective hung ceilings and within the enclosed space in building of Type 1 and Type 2 construction within which, other than the enclosure, fire protection of steel is not required, pipes, wires, conduits and ducts may be placed, provided they are so arranged and so secured that they will not, either by expanding in the event of fire, or otherwise impair, the effectiveness of the enclosing protective materials. Electric conduits and wires and gas pipes may be embedded in concrete or masonry fire protection of structural steel where the protective material is reinforced with wire mesh, provided they shall have protective covering except over the tops of beams and girders, at least as thick as required for the steel.

F-402.2.26 Damage protection: In factories, garages, warehouses and other buildings in which the fire-protective covering required for steel or iron columns may be damaged by the movement of vehicles, materials or equipment, such covering shall be protected by metal or other material in a manner satisfactory to the building official.

F-402.2.27 Firestopping: Firestopping shall mean the stopping off or enclosure at the ends and wherever else specified of the spaced between studs of partitions, joists of floors and roofs and other similar spaces to prevent drafts of air and the communication of fire from one such space to another. Fire-stopping shall consist of wood not less than 1½ inches thick, of sheet metal not less than No. 24 gauge or of masonry, or a combination of such materials. Firestopping shall be tightly fitted in the space to be filled, about pipes, wires and ducts and, if cut or disturbed in the placement of pipes, wires and ducts, shall be repaired.

F-402.3 Fire protection of steel columns:

F-402.3.1 Protective thickness: Structural steel columns required to have fire protection of a given rating shall be covered on all sides with protective material having not less than the thickness necessary for the required rating. Except where "no fill" is specified, re-entrant and other accessible spaces behind the specified outer protection shall be filled with concrete or brick masonry or the material of the outer protection.

F-402.3.2 Fireresistance rating: Materials shall be assumed to afford to steel columns fire protection of the rating indicated in the following Appendix F-402.3.3 through F-402.3.6:

F-402.3.3 Four hour rating:

1. Two inches Class 1 concrete.
2. Three inches Class 2 concrete, metal mesh reinforcement.
3. 3½ inches brick masonry.
4. Two layers two inch structural clay partition tile masonry, metal mesh in beds.
5. Two inches structural clay partition tile masonry, concrete fill, metal mesh in beds, ¾ inch gypsum plaster.
6. Four inches structural clay partition tile masonry, concrete fill, metal mesh in beds, ⅝ inch lime plaster.
7. Four inches structural clay partition tile or concrete block masonry, concrete fill, plaster.
8. Three inches hollow gypsum tile masonry and plaster.
9. Two inches gypsum concrete, metal mesh reinforcement.
10. Two inches solid gypsum tile masonry and plaster.
11. Three inches solid cinder concrete block masonry and plaster.
12. Four inches hollow cinder concrete block masonry and plaster

F-402.3.4 Three hour rating:

1. 1¾ inches Class 1 concrete.
2. Two inches Class 2 concrete, metal mesh reinforcement.
3. Two inches gypsum concrete.
4. Two inches solid cinder concrete block masonry and plaster.
5. Two inches structural clay partition tile masonry, concrete fill.
6. Four inches structural clay partition tile masonry, concrete fill, metal mesh in beds, ⅝ inch lime plaster.

F-402.3.5 Two hour rating:

1. 1½ inches Class 1 concrete.
2. Two inches Class 2 concrete, metal mesh reinforcement.
3. One inch Class 1 or Class 2 concrete encased in standard weight steel or wrought iron pipe.
4. Two inches structural clay partition tile masonry and plaster.
5. Two layers plaster, each on metal lath, with ¾ inch air space between, two inches total thickness.
6. Two inches gypsum concrete.
7. Two inches solid or three inches hollow gypsum tile masonry.

F-402.3.6 One hour rating:

1. One inch Class 1 concrete.
2. 1½ inches Class 2 concrete with metal mesh reinforcement.
3. 2¼ inches brick masonry.
4. Two inches structural clay partition tile or concrete block masonry.
5. One inch cement or gypsum plaster on metal lath.

F-402.3.7 Thickness: The thickness of protection on the outer edges of lugs or brackets need not exceed one inch.

F-402.4 Fire protection of cast iron columns:

F-402.4.1 Protective thickness: Cast iron columns required to have fire protection of a given rating shall be covered on all sides with protective materials having not less than the thickness necessary for the required rating. Re-entrant spaces, if any on the exterior of cast iron columns, and other accessible spaces behind the specified protection, shall be filled with Class 1 concrete or brick masonry or the material of the outer protection.

F-402.4.2 Fireresistance rating: Materials shall be assumed to afford to cast iron columns fire protection of the rating indicating in the following Appendix F-402.4.3 through F-402.4.5:

F-402.4.3 Four hour rating: Cast iron columns shall not be used where the protection of a four hour rating is required.

F-402.4.4 Three hour rating:

1. Two inches Class 2 concrete.
2. Three inches Class 2 Concrete, metal mesh reinforcement.
3. Two inches structural clay partition tile or concrete block masonry concrete fill.
4. 1½ inches cement or gypsum plaster on metal lath and metal furring to form ½ inch air space.
5. 1½ inches Class 1 concrete.
6. Two inches Class 2 concrete with metal mesh reinforcement.

F-402.4.5 One hour rating:

1. One inch Class 1 concrete.
2. 1½ inches Class 2 concrete with metal mesh reinforcement.
3. One inch cement or gypsum plaster on metal lath.

F-402.5 Fire protection of steel in reinforced concrete columns:

F-402.5.1 Protection thickness: The main steel reinforcement, including spiral reinforcement and ties larger than ½ inch, in reinforced concrete columns required to have fire protection of a given rating shall be covered with concrete having not less than the thickness listed in Appendix F-402.5 for the rating indicating in the following Appendix F-402.5.2 through F-402.5.6.

F-402.5.2 Four hour rating:

1. 1½ inches Class 1 concrete.
2. Two inches Class 2 concrete.

F-402.5.3 Three hour rating: 1½ inches Class 1 or Class 2 concrete.

F-402.5.4 Two hour rating:

1. One inch Class 1 concrete.
2. 1½ inches Class 2 concrete.

F-402.5.5 One hour rating: One inch Class 1 or Class 2 concrete.

F-402.5.6 Ties less than ½ inch: The thickness of protection on column ties not larger than ½ inch may be ½ inch may be ½ inch thinner than that listed above.

F-402.6 Fire protection of steel beams, girders, and trusses:

F-402.6.2 Protective thickness: Steel beams, girders and trusses or the members of trusses, required to have fire protection of a given rating, shall be covered on all sides with material having not less than the thickness necessary for the required rating.

F-402.6.3 Four hour rating:

1. Two inches Class 1 concrete.
2. Three inches Class 2 concrete.
3. Three inches structural clay partition tile or concrete block masonry and plaster.
4. Three inches hollow gypsum tile masonry and plaster.
5. Two inches gypsum concrete.
6. Two inches solid gypsum tile masonry and plaster.

F-402.6.4 Three hour rating:

1 1¾ inches Class 1 concrete.

2. 2½ inches Class 2 concrete.
3. Two inches gypsum concrete.
4. Two inches structural clay partition tile, or concrete block masonry and plaster.
5. Two inches solid, or three inches hollow gypsum tile masonry.

F-402.6.5 Two (2) hour rating:

1. 1½ inches of Class 2 concrete.
2. Two inches gypsum concrete.

F-402.6.6 One hour rating:

1. One inch Class 1 concrete.
2. 1½ inches Class 2 concrete.
3. ⅞ inch or cement or gypsum plaster on metal lath.

F-402.7 Fire protection of steel in reinforced concrete beams:

F-402.7.1 Protective thickness: The main steel reinforcement, including stirrups larger than ½ inch, in reinforced concrete beams, girders and trusses, including the ribs of reinforced concrete ribbed floors or roofs where one or both sides of the ribs, in addition to the soffit, are exposed to fire, required to have fire protection of a given rating, shall be covered on all sides with concrete having not less than the thickness listed in Appendix F-402.7 for the required rating. Where a reinforced concrete floor or roof has a flush ceiling formed with approved permanent masonry filler between ribs, the reinforcement shall have the protection required for reinforcing steel of floors and roofs in Appendix F-402.8.

F-402.7.2 Four hour rating:

1. 1½ inches Class 1 concrete.
2. Two inches Class 2 concrete.

F-402.7.3 Three hour rating: 1½ inches Class 1 or Class 2 concrete.

F-402.7.4 Two hour rating:

1. One inch Class 1 concrete.
2. 1½ inches Class 2 concrete.

F-402.7.5 One hour rating: One inch Class 1 or Class 2 concrete.

F-402.7.6 Stirrups less than ½ inch: The thickness of protection on stirrups not larger than ½ inch may be less than that listed by not more than ½ inch.

F-402.8 Fire protection of steel reinforcing in floors and roofs:

F-402.8.1 Protection thickness: The steel reinforcement in reinforced concrete floors and roofs with flush or plane ceiling, such that the exposure to fire is on the soffit only, required to have fire protection of a given rating, shall be covered with concrete having not less than the thickness listed in Appenfix F-402.8 for the required rating. In floors or roofs having reinforced concrete ribs where the concrete surrounding the steel reinforcement is exposed to fire on one or both sides in addition to the soffit, such reinforcement shall have the protection specified in Appendix F-402.7 for steel in reinforced concrete beams.

F-402.8.2 Four hour rating:

1. One inch Class 1 concrete.

2. 1¼ inches Class 2 concrete.

F-402.8.3 Three hour rating: One inch Class 1 or Class 2 concrete.

F-402.8.4 Two hour rating:

1. ¾ inch Class 1 concrete.
2. One inch Class 2 concrete.

F-402.8.5 One hour rating: ¾ inch Class 1 or Class 2 concrete.

F-402.9 Fireresistive floor and roof construction:

F-402.9.1 Protective thickness: Floors and roofs required to have resistance of a given rating to the spread of fire shall have such thickness of the materials of which it is constructed, as shall be necessary for the required rating, and structural metal forming a part of such floors or roofs shall have protection against fire of such required rating. Floors and roofs required to have two hour or longer resistance to fire be constructed of noncombustible materials. Granolithic, burned clay tile, ceramic tile or other similar incombustible floor finish of a given thickness may be substituted for an equal thickness, and sand, cinder or other incombustible filling material, with or without embedded wooden screeds, may be substituted for ⅔ its thickness, of the floor or roof construction material specified in Appendix F-402.9, provided that such floors and roofs shall have adequate thickness for structural purposes.

F-402.9.2 Fireresistance rating: Floor or roof construction shall be assumed to afford resistance to the spread of fire of the rating indicated in the following Appendix F-402.9.3 through F-4029.6:

F-402.9.3 Four hour rating:

1. Four inches solid slab of reinforced Portland cement concrete or reinforced precast gypsum concrete.
2. Four inches solid masonry arched or slabs.
3. Four inches structural clay floor tile masonry arches or slabs with top covering of not less than two inches of solid masonry or reinforced concrete.
4. Five inches combination reinforced Portland cement concrete slab consisting of permanent fillers of concrete block, gypsum or structural clay tile and 1½ inches of concrete topping; but if structural clay partition tiles are used for fillers, they shall be plastered on the soffit.

F-402.9.4 Three hour rating:

1. Three inches solid slab of reinforced Portland cement concrete or reinforced precast gypsum concrete.
2. Three inches solid masonry arches or slabs.
3. Four inches structural clay floor tile masonry, arches or slabs with top covering of not less than 1½ inches of solid masonry or reinforced concrete.
4. Four inches combination reinforced Portland cement concrete slab consisting of permanent fillers of concrete block, gypsum or structural clay tile and one inch concrete topping; but if structural clay partition tiles are used for fillers, they shall be plastered on the soffit.

F-402.9.5 Two hour rating:

1. 2½ inches solid slab of reinforced Portland cement concrete or reinforced precast gypsum concrete.
2. 2½ inches solid masonry arches or slabs.
3. Three inches structural clay floor tile masonry, arches or slabs with top covering of not less than one inch of solid masonry or reinforced concrete.

F-402.9.6 One hour rating:

1. Three inches structural clay floor tile masonry, arches or slabs with all joints thoroughly filled with cement or gypsum mortar.
2. Wood floor or roof construction with joists not less than 1⅝ inches in least dimension, firestopped, double board floor, approved asbestos felt between lay of boards, and with a ceiling of at least ¾ inch cement or gypsum plaster on metal lath.
3. Steel beams or steel joists not more than 36 inches apart on centers with noncombustible floor and a ceiling of at least ¾ inch cement or gypsum plaster on metal lath furring.

F-402.10 Fireresistive ceiling construction:

F-402.10.1 Protective thickness: Ceilings required to afford fire protection of a given rating to the floor or roof framing under which it is supported shall be of fireresistive materials of at least the thickness necessary for the given rating. A fireresistive ceiling and all hangers and fastenings necessary for its support to the protected framing shall be of noncombustible materials. It shall be capable of sustaining its own weight without exceeding allowable stresses. Metal reinforcement in such a ceiling shall be protected from fire as specified in Appendix F-402.8 for reinforcing in a floor.

F-402.10.2 Fireresistance rating: Ceiling construction shall be assumed to afford to floor or roof framing fire protection of the rating indicated in the following Appendix F-402.10.3 through F-402.10.6.

F-402.10.3 Four hour rating:

1. 2½ inches solid slab of reinforced Portland cement concrete or reinforced precast gypsum concrete.

2. Two inches precast reinforced gypsum concrete, plastered.

F-402.10.4 Three hour rating:

1. Two inches solid slab of reinforced Portland cement concrete or reinforced precast gypsum concrete.
2. Two inches precast reinforced gypsum concrete, lapped or rabbeted joints.

F-402.10.5 Two hour rating: 1½ inches solid slab of reinforced Portland cement concrete or reinforced precast gypsum concrete.

F-402.10.6 One hour rating: ¾ inch cement or gypsum plaster on metal lath.

F-402.11 Fireresistive bearing walls and partitions:

F-402.11.1 Protective thickness: Bearing walls and partitions required to have resistance to fire or the spread of fire of a given rating shall be constructed of fireresistive materials and shall have at least the thickness necessary for the required rating. Walls required to have two hour or longer rating shall be of noncombustible materials. Steel reinforcement in reinforced concrete walls shall have the same protection for the given rating as is required in Appendix F-402.9 for floors.

F-402.11.2 Fireresistance rating: Bearing walls and partitions shall be assumed to have resistance to fire and the spread of fire of the rating indicated in the following Appendix F-402.11.3 through F-40211.6:

F-402.11.3 Four hour rating:

1. Eight inches solid brick masonry.
2. 12 inches hollow wall of brick masonry, minimum eight inch masonry thickness.
3. 12 inches structural clay load-bearing tile masonry with two units and not less than three cells in the thickness of the wall.
4. Eight inches structural clay load-bearing tile masonry with one unit and not less than two cells in the thickness of the wall, plastered both sides.
5. 12 inches concrete block masonry with one unit and not less than two cells in the thickness of the wall.
6. Eight inches one piece concrete block masonry with shells and webs at least 1½ inches thick, plastered both sides.
7. 12 inches total thickness of brick masonry facing bonded to structural clay load-bearing tile masonry backing.
8. Eight inches solid concrete.
9. Six inches solid reinforced concrete.
10. A steel or reinforced concrete frame bearing wall in which the steel has fire protection of four hour rating, with panel filling as specified in Appendix F-402.12 for a nonbearing wall of four hour rating.

F-402.11.4 Three hour rating:

1. Eight inches structural clay load-bearing tile masonry with two units and not less than four cells in the thickness of the wall.
2. 12 inches structural clay load-bearing tile masonry with one unit and not less than three cells in the thickness if the wall.
3. Eight inches one piece concrete block masonry with shells and webs not less than 1½ inches thick, plastered both sides.
4. Eight inches one piece concrete block masonry with shells and webs not less than two inches thick.
5. Five inches solid reinforced concrete.
6. A steel or reinforced concrete frame bearing wall in which the steel has fire protection of three hour rating, with panel filling as specified in Appemdix F-402.12 for a nonbearing wall of three hour rating.

F-402.11.5 Two hour rating:

1. Eight inches structural clay load-bearing tile masonry with not less than three cells in the thickness of the wall.
2. Eight inches concrete block masonry with shells and webs not less than 1½ inches thick.
3. A steel or reinforced concrete frame bearing wall in which the steel has fire protection of two hour rating, with panel filling as specified in Appendix F-402.12 for a nonbearing wall of two hour rating.

F-402.11.6 One hour rating:

1. A steel or wooden stud bearing wall covered on both sides with one inch cement or gypsum plaster on metal lath, firestopped if of wood.
2. A steel or reinforced concrete frame bearing wall in which the steel has fire protection of one hour rating, with panel filling as specified in Appendix F-402.12 for a nonbearing wall of one hour rating.

F-402.12 Fireresistive nonbearing walls and partitions:

F-402.12.1 Protective thickness: Nonbearing walls and partitions required to have resistance to fire and the spread of fire of a given rating shall be constructed of fireresistive materials and shall have at least the thickness necessary for the required rating. Walls required to have two hour or longer rating shall be of incombustible materials. Steel reinforcement in reinforced concrete walls shall have the same protection for the given rating as is required in Appendix F-402.8.

F-402.12.2 Fireresistance rating: Nonbearing walls and partitions shall be assumed to have resistance to fire and the spread of fire of the rating indicated in the following Appendix F-402.12.3 through F-402.12.6.

F-402.12.3 Four hour rating:

1. Eight inches solid brick masonry.
2. 3½ inches solid brick masonry, plastered goth sides.
3. Six inches structural clay load-bearing tile, plastered both sides.
4. Six inches solid concrete.
5. Four inches solid reinforced concrete.
6. Any wall which, as a bearing wall, has a three hour or four hour rating in Appendix F-402.11, except the steel or reinforced concrete frame bearing wall.

F-402.12.4 Three hour rating:

1. 3½ inches solid brick masonry.
2. Four inches structural clay load-bearing tile, plastered both sides.
3. Four inches solid concrete.
4. Three inches reinforced concrete.
5. Any wall which, as a bearing wall, has a two hour rating in Appendix F-402.11 except the steel or reinforced concrete frame bearing wall.

F-402.12.5 Two hour rating:

1. Three inches gypsum tile masonry plastered both sides except in exterior walls.
2. Eight inches structural clay partition tile masonry, plastered both sides.
3. Eight inches structural clay load-bearing tile, with three cells in the thickness of the wall.
4. 2½ inches solid cement or sanded gypsum plaster on metal lath and noncombustible studding.
5. Three inches total thickness of hollow wall, ¾ inch cement or gypsum plaster on metal lath and noncombustible studding.
6. Three inches total thickness of hollow wall, ¾ inch cement or gypsum plaster on metal lath and wooden studding, firestopped.

F-402.13 Fireresistive doors:

F-402.13.1 General: Doors which are required to be fire doors, fireresistive doors, or of fireresistive construction shall conform to the requirements of Appendix F-402.13 and Appendix F-402.14

F-402.13.2 Classification: Fire doors shall be classified for the proposes of this code as Class A, Class B, and Class C.

F-402.13.3 Class A fire doors: Class A fire doors shall be doors of the following construction and as specified in Appendix F-402.14:

1. Tin-clad, three ply wood core, sliding.
2. Tin-clad, three ply wood core, swinging single leaf, doorway not over six feet wide.
3. Tin-clad, three ply wood core, swinging in pairs, doorway not over feet wide.
4. Hollow metal, swinging single leaf, doorway not over four feet wide.
5. Hollow metal, swinging in pairs, doorway not over eight feet wide.
6. Sheet metal, sliding, single, doorway not over ten feet wide.
7. Sheet metal, sliding in pairs, doorway not over 12 feet wide.
8. Sheet metal, swinging single leaf, doorway not over feet wide.
9. Sheet metal, swinging in pairs, doorway not over ten feet wide.
10. Steel rolling doorway not over 12 feet wide.
11. Steel plate, doorway not over four feet wide.
12. Any other construction equal or superior to a tin-clad three ply wood core door in a standard fire test, for resistance to fire, the spread of fire and smoke, and transmission of heat.

F-402.13.4 Class B fire doors: Class B fire doors shall be doors of the following construction and as specified in Appendix F-402.14:

1. Tin-clad, three ply wood core.
2. *Tin-clad, two ply wood core, sliding, doorway not over ten feet wide.*
3. Tin-clad, two ply wood core, swinging single leaf, doorway not over six feet wide.
4. Tin-clad, two ply wood core, swinging in pairs, doorway not over ten feet wide.
5. Hollow metal, sliding, doorway not over eight feet wide.
6. Metal-clad, paneled, swinging single leaf, doorway not over three feet wide.
7. Metal-clad, paneled, swinging in pairs, doorway not over six feet wide.
8. Any other construction equal or superior to a tin-clad two ply wood core door in a standard fire test, for resistance to fire, the spread of fire and smoke, and transmission of heat.

F-402.13.5 Class C fire doors: Class C Fire doors shall be doors of the following construction and as specified in Appendix F-402.14:

1. Metal-clad, paneled, swinging single leaf, doorway not over four feet wide.
2. Metal-clad, paneled, swinging in pairs, doorway not over eight feet wide.

F-402.13.6 Substitution: A Class A door may be used where Class b or Class C is specified; a Class B door may be used where Class C is specified. Two Class B or Class C doors on opposite sides of the wall may be used where a single Class A or Class B door is specified.

F-402.13.7 Overlap: Fireresistive doors, when closed, shall completely cover the doorways in the walls and partitions or the openings in the floors or roofs to which they ar fitted. A swinging fire door shall either overlap both jambs and the head of the opening not less than four inches or be fitted to a fireresistive frame with a rabbet the full thickness of the door and with not less than ½ inch overlap on the door. A sliding fire door, except in enclosures about passenger elevators, shall overlap both jambs and the head of the opening not less than four inches. A sliding fire door in an enclosure about a passenger elevator shall overlap jambs, head and adjoining panels not less than ½ inch. Fire doors shall fit closely at the floor with clearance of not over ¼ inch.

F-402.13.8 Thresholds: In buildings with combustible floors, doorways required to have fire doors shall have noncombustible thresholds the full thickness of the wall, extending at least four inches from the face of the wall where a door is hung and extending laterally at least six inches behind each jamb of the doorway. Thresholds may be flush with the floor.

F-402.13.9 Rabbeted frame: The rabbeted frame of a swinging fire door shall be constructed of structural steel built into the concrete, masonry or other fireresistive material of the wall about the opening and secured thereto, except that the rabbeted frame of a Class B or C door may be of wood, covered with sheet metal not less than No. 26 gauge in thickness, secured to the wall in the opening.

F-402.13.10 Fit: Fire doors when closed shall fit tightly against the wall or frame so as to provide an effective stop for fire and smoke. Except for the metal-covered wooden frame specified in Appendix F-402.10, combustible material shall not intervene between the door and the fireresistive material of the wall, floor or roof to which it is fitted.

F-402.13.11 Hardware: Hinge hardware for fire doors shall be of malleable iron or rolled structural steel not less than ¼ inch thick except that tubular steel track for sliding doors may be not less than ⅛ inch thick. Equivalent thickness of solid bronze or brass may be used. Fire doors shall not depend upon cords, cables or chains to support them in closed position except in elevator shafts.

F-402.13.12 Tracks: Tracks for sliding fire doors shall be so supported that a track hanger comes at each door hanger when the door is closed. Track hangers shall be secured to wood stud walls by through bolts and to concrete walls by through bolts or approved built-in inserts. Expansion shields shall not be used to support fire doors.

F-402.13.13 Hinges: Hinges for swinging fire doors, except in wooden stud walls, shall be riveted or through-bolted to the structural steel frame of the opening, through-bolted to the wall if of masonry or concrete or secured by approved inserts in the concrete or built into masonry in an approved manner

F-402.13.14 Strap hinges: Strap hinges and sliding door hangers shall be secured to fire doors by through-bolting, riveting or welding. Swinging fire doors in rabbeted frames, except tin-clad, wood core doors, may be hung on butts. Other swinging fire doors shall have strap hinges.

F-402.13.15 Straps, locks and latches: Sliding fire doors shall have adequate stops for the closed position. Swinging Class A fire doors shall have surface lathes or unit locks. Class B and C doors shall have surface latches, unit or mortise locks. The latch bolts of unit or mortise locks on fire doors shall have a throw of ¾ inch. When mounted in pairs, fire doors shall be rabbeted by means of an astragal or otherwise where they come together. One of a pair of swinging fire doors shall have push bolts at top and bottom with a throw of ¾ inch and the other shall be held by latch to the first.

F-402.13.16 Opening hardware: Except in detention buildings, fire doors hung in required exits shall be so fitted with hardware that they can be opened from inside without use of a key when the building is occupied.

F-402.14 Fire door construction:

F-402.14.1 Fastening: In the construction of fire doors, solder shall not be used except for filling joints. Sheet metal shall be fastened to wood by nailing and to metal frame by bolting, riveting or welding.

F-402.14.2 Glass: Class A doors shall not have glass panels. Class B doors may have glass panels not larger than 100 square inches in exposed area nor more than 12 inches in width or height. Class C doors amy have glass panels not larger than 2,016 square inches in total exposed area, and any single light shall not have an exposed area exceeding 1,296 square inches. Glass in fire doors shall be wire glass not less than ¼ inch thick and shall be set ⅝ inch in grooves ¾ of an inch deep.

F-402.14.3: Deleted

F-402.14.4 Tin-clay, two ply: In-clad, two ply wood core doors shall be shall be constructed in accordance with the specifications of the National Board of Fire Underwriters for such doors in Class B openings and shall bear the label of the Underwriters' Laboratories to this effect.

F-402.14.5 Hollow metals: Hollow metal doors shall have substantial stiles and rails of heavy pressed steel, reinforced for hinges and other hardware. Panels shall be of sheet filled with asbestos board or other approved insulating materials. The door shall be assembled by welding or riveting.

F-402.14.6 Sheet metals: Sheet metal doors shall be constructed with a rolled steel rigid frame covered both sides with $^1/_{16}$ inch asbestos board and No. 26 gauge corrugated steel metal, with corrugations vertical on one side and horizontal on the other, bound on the edges with rolled steel or pressed steel shapes.

F-402.14.7 Steel rolling: A steel rolling fire door shall be constructed of sheet steel interlocking slats, sliding in grooves, counterweighted by springs, with the roller and mechanism enclosed in heavy sheet metal.

F-402.14.8 Steel plate: A steel plate fire door shall be constructed of not less than No. 12 gauge steel plate mounted on a rolled steel frame, assembled by welding or riveting.

F-402.14.9 Metal clad: A metal clad, paneled fire door shall have a wood core with stiles and rails not less than 1¾ inches thick covered with No. 26 gauge sheet steel; panels ¾ inch thick covered with No. 26 gauge sheet steel, set ¾ inch in grooves; joints of metal lapped and well nailed.

F-402.14.10 Class A label: A door properly bearing the Underwriters' label certifying that it is suitable for the protection of a Class A opening shall be acceptable as a Class A door.

F-402.14.11 Class B label: A door properly bearing the Underwriters' label certifying that it is suitable for the protection of a Class B opening shall be acceptable as a Class B door, except that metal clad doors wider than three feet shall not be accepted as Class B doors.

F-402.14.12 Class C label: A door properly bearing the Underwriters' label certifying that it is suitable for the protection of a Class C opening shall be acceptable as a Class C door.

F-402.15 Fireresistive shutters: Shutters required to be fire shutters or fireresistive shutters shall be constructed and hung as specified for Class B fireresistive doors in Appendix F-402.13 and F-402.14.

F-402.16 Fireresistive windows:

F-402.16.1 General: Windows which are required to be fire windows, fireresistive windows, or of fireresistive construction shall conform to the requirements of Appendix F-402.16.

F-402.16.2 Moveable: Firereisistive windows may be fixed or arranged to open and close. Fixed fireresistive windows shall be so secured in the walls in which they are placed that they may expand in case of fire without buckling. Moveable firereisitive windows shall be opened or closed in one of the following manners:

1. One or more sashes may slide horizontally in a fireresistive frame.
2. One or more sashes may slide vertically with counterweights or with tow sashes counterbalanced and hung on chains. If a sash is closed in raised position, it shall have a fastening.
3. A sash may be hinged at top, bottom, or either side.
4. A sash may be pivoted at top and bottom or at the sides.
5. A sash may be arranged to open and close in any other approved manner, with approved hardware.

F-402.16.3 Sash: Moveable sashes in fireresistive windows shall be furred to fireresistive frames of the same or similar construction. Both sashes and frames, and metal mullions between window units, shall be so fitted in the walls in which they are placed as to be continuous with the fireresistive material of the wall and so secured that they may expand in case of fire without buckling.

F-402.16.4 Glass: Glass in firereisistive windows shall be wired glass not less than ¼ inch thick and the area of a single light shall not exceed 720 square inches. Glass shall be set ⅜ inch grooves at least ½ inch deep. Glass shall be secured by glazing angles or molding screwed to the sash and forming continuous grooves for the glass.

F-402.16.5 Construction: Fireresistive windows shall be of the following construction:

1. Hollow sheet metal sashes and frames fabricated by pressing, welding, riveting or crimping without the use of solder or other fusible alloy, except for filling joints, and bearing the label of Underwriters' Laboratories.
2. Rolled steel or pressed steel sashes fabricated by pressing, welding, riveting or crimping, of a make and style approved by the commissioner.
3. Any other approved constructions as fireresistive as that specified in Appendix F-402.16.5 item.

F-402.16.6 Hollow sheet metal: Fired fireresistive windows of hollow sheet metal construction shall not exceed seven feet in width not ten feet in height. Fireresistive windows of hollow sheet metal construction with moveable sashes shall not exceed six feet in width nor ten feet in height.

F-402.16.7 Rolled steel: Fireresistive windows of rolled steel construction shall not exceed 84 square feet in area not 12 feet in either height or width.

F-402.16.8 Wind pressure: Fireresistive windows and their fastenings shall be capable of resisting the wind pressure on the wall of the building applied either on he inside or the outside of the window exceeding allowable stresses.

F-402.16.9 Substitution: Where fireresistive windows are required, wooden windows and plain glass may be substituted provided the openings are protection by fireresistive doors or shutters, or, in buildings of approved occupancy and construction, by an approved system of open sprinklers.

F-402.17 Fireresistive roof covering:

F-402.17.1 Classification: Roof covering allowed under this code shall be classified as fire-retardant or ordinary, according to resistance to fire outside, as provided in Appendix F-402.17. Fire-retardant roof covering is the more firereisistive and may be used where fire-retardant roofing is specified. Roof covering less fireresistive than ordinary roof covering shall not be used on any building.

F-402.17.2 Fire-retardant roofing: Fire-retardant roofing shall be any roof covering than meets the requirements of Class A or Class B roofing under the specifications of the Underwriters' Laboratories, Inc. The following roof covering shall be assumed to meet the requirements for fire-retardant roofing:

1. Built-up roofing consisting of successive layers of roofing felt impregnated with asphalt; a final layer of asphalt in which, while molten, is embedded a continuous layer of roofing gravel or slag.
2. Built-up roofing consisting of successive layers of roofing felt impregnated with coal tar; a final layer of tar in which, while molten, is embedded a continuous layer of roofing gravel or slag.
3. Built-up roofing consisting of successive layers of roofing felt impregnated with asphalt; a final layer of asbestos roofing felt impregnated with asphalt weighing not less than 14 pounds per 100 square feet, or a final layer of asphalt-saturated prepared roofing coated with granulated slate or other similar material.
4. Built-up roofing consisting of successive layers of roofing felt impregnated with tar or asphalt and a finish of burned clay floor tile, stone flagging, cement concrete or other similar material.
5. Sheet metal with locked and soldered joints not less than No. 26 gauge in thickness.
6. Shingles of natural slate.
7. Shingles of burned clay tile.
8. Shingles of sheet metal not less than No. 26 gauge in thickness.
9. Shingles of asbestos board not less than ⅛ inch thick.
10. Shingles of asphalt saturated felt surfaced with granulated slate or other similar material and carrying the Underwriters Class "C" label.
11. Corrugated sheet metal with lapped joints not less than No. 26 gauge in thickness.
12. Corrugated asbestos board not less than $^{3}/_{16}$) inch thick.

F-402.17.3 Ordinary roofing: Ordinary roofing shall be of any roof covering which meets the requirements of Class C roofing under the specifications of the Underwriters' Laboratories, Inc. The following roof covering shall be assumed to meet the requirements for ordinary roofing:

1. Built-up roofing consisting of successive layers of roofing felt impregnated with asphalt, coal tar or other approved material, not equal in fireresistance to a fire-retardant roofing.
2. Prepared roofing consisting of felt or fabric impregnated or coated, or both, with asphalt, tar or other approved material or shingles of such prepared roofing, not equal in fireresistance to fire-retardant roofing.
3. Canvas stretched tightly and coated with paint.

F-402.17.4 Means of securing: Built up roofing shall be secured to the roof deck in the following manner:

1. Over masonry slab, the first layer shall be laid in molted asphalt or tar mopped on the roof deck, after the deck is properly primed, or by nailing a layer of building paper to nailing inserts other than wood placed in the deck.
2. Over wood decks, the built-up roofing shall be secured by nailing a layer of building paper to the roof deck over which the prepared roofing is to be laid with the first layer laid in molten asphalt or tar.
3. Roofings other than built-up roofings, such as shingles, slates, and tile roll roofing shall be well secured to the deck by nailing, bolting, wiring, or other approved methods.

APPENDIX G

UNIT DEAD LOADS FOR DESIGN PURPOSES

The intent of 780 CMR Appendix G is to assist the designer and building official in establishing the minimum weights for materials commonly used in building construction. Some material assemblies have a range in weight. A typical figure is indicated, but when there is reason to suspect a considerable deviation, the actual weight should be determined.

Note on use of 780 CMR Appendix G tables: When making calculations based on the tables in 780 CMR Appendix G, the weights of masonry include mortar but not plaster. For plaster, add 5 psf for each face plastered. Values given represent averages. In some cases there is a considerable range of weight for the same construction. For metric conversion, 1 psf equals 4.882 kg/m^3.

Table G-1
UNIT DESIGN DEAD LOADS FOR CONCRETE SLABS

Concrete slabs	Pounds per square foot
Concrete, reinforced stone, per inch of thickness	12½
Concrete, reinforced lightweight sand, per inch of thickness	9½
Concrete, reinforced, lightweight, per inch of thickness	9
Concrete, plain stone, per inch of thickness	12
Concrete, plain, lightweight, per inch of thickness	8½

Table G-2
UNIT DESIGN DEAD LOADS FOR RIBBED SLABS

	Pounds per square foot					
Ribbed slabs Depth in inches (rib depth plus slab thickness)*	Width of rib, in inches					
	4	5	6	7	8	9
12-inch clay tile fillers (normal weight concrete)						
4 plus 2	49	51	52	54	-	-
6 plus 2	60	63	65	67	-	-
8 plus 2½	79	82	85	87	-	-
10 plus 3	96	100	103	106	-	-
12 plus 3	108	112	116	120	-	-
20-inch wide forms:	45	48	50	50	-	-
6 plus 2½	51	54	57	60	-	-
8 plus 2½	57	60	64	68	-	-
10 plus 2½	63	67	72	76	-	-
12 plus 2½	-	74	79	84	-	-
14 plus 2½	-	-	88	93	98	-
16 plus 2½	-	-	-	111	118	-
20 plus 2½		-				

* Make appropriate allowances for tapered ends.

Table G-2 (continued)
UNIT DESIGN DEAD LOADS FOR RIBBED SLABS

Ribbed slabs Depth,, in inches (rib depth plus slab thickness)*	Pounds Per square foot Width of rib, in inches					
	4	5	6	7	8	9
30-inch wide forms:						
6 plus 2½	41	43	45	47	-	-
8 plus 2½	45	47	50	53	-	-
10 plus 2½	49	52	55	58	-	-
12 plus 2½	53	57	60	64	-	-
14 plus 2½	-	62	66	70	-	-
16 plus 2½	-	-	72	76	80	-
20 plus 2½	-	-	-	90	95	101
Two-way clay tile fillers (12x12):						
4 plus 2	61	62	64	-	-	-
6 plus 2	87	89	90	-	-	-
8 plus 2½	100	103	107	-	-	-
10 plus 3	121	126	131	-	-	-
12 plus 3	136	141	146	-	-	-

Table G-3
UNIT DESIGN DEAD LOADS FOR WAFFLE SLABS

Waffle slabs Depth, in inches (Rib depth plus slab thickness)	Pounds per square foot
19x19, 5 @ 24	
6 plus 2½	66
8 plus 2½	78
10 plus 2½	84
12 plus 2½	101
30x30, 6 @ 36	
8 plus 3	73
10 plus 3	83
12 plus 3	95
14 plus 3	106
16 plus 3	114
20 plus 3	135

Table G-4
UNIT DESIGN DEAD LOADS FOR FLOOR FINISH

Floor finish	Pounds per square foot
Double ⅞-inch wood on sleepers, light concrete fill	19
Double ⅞-inch wood on sleepers, stone concrete fill	28
Single ⅞-inch wood on sleepers, light concrete fill	16
Single ⅞-inch wood on sleepers, light concrete fill	25
3-inch wood block on mastic, no fill	10
1-inch cement finish on stone concrete fill	32
1-inch terrazzo on stone concrete fill	32
Marble and mortar on stone concrete fill	33
Linoleum on stone concrete fill	32
Linoleum on light concrete fill	22
1½-inch asphalt mastic flooring	18
3-inch wood block on ½-inch mortar base	16
Solid flat tile on 1-inch mortar base	23
2-inch asphalt block, ½- mortar	30
1-inch terrazzo, 2-inch stone concrete	32
Floor finish tile per inch depth	12
Cement finish per inch depth	12
Gypsum slabs per inch depth	4
Precast concrete plank per inch	(as determined by test)
Hardwood flooring per inch depth	4
Underflooring per inch depth	3
Linoleum	2
Asphalt tile	2
Brick pavers per inch thickness	10

Table G-5
UNIT DESIGN DEAD LOADS FOR WATERPROOFING

Waterproofing	Pounds per square foot
Five-ply membrane	5

Table G-6
UNIT DESIGN DEAD LOADS FOR FLOOR FILL

Floor Fill	Pounds per square foot
Cinder fill, per inch	5
Cinder concrete per inch	9
Lightweight concrete, per inch	7
Sand, per inch	8
Stone, concrete, per inch	12

Table G-7
UNIT DESIGN DEAD LOADS FOR WOOD JOIST FLOORS

Wood joist floors (no plaster) - double wood floor joist sizes in inches	Pounds per square foot 12-inch spacing	Pounds per square foot 16-inch spacing
2 x 6	6	5
2 x 8	6	6
2 x 10	7	6
2 x 12	8	7
3 x 6	7	6
3 x 8	8	7
3 x 10	9	8
3 x 12	11	9
3 x 14	12	10

Table G-8
UNIT DESIGN DEAD LOADS FOR MATERIALS

Materials	Pounds per cubic foot
Cast stone masonry (cement, stone, sand)	144
Cinder fill	57
Concrete, plain:	
Cinder	108
Expanded slag aggregate	100
Haydite (burned clay aggregate)	90
Slag	132
Stone (including gravel)	144
Vermiculite and perlite aggregate, nonloadbearing	25-50
Other light aggregate, loadbearing	70-105
Concrete, reinforced:	
Cinder	111
Slag	138
Stone (including gravel)	150
Earth (dry)	96
Earth (damp)	108
Earth (wet)	120
Cork	15
Masonry, ashler:	
Granite	168
Limestone, crystalline	168
Limestone, oolitic	135
Marble	173
Sandstone	144
Masonry, rubble mortar:	
Granite	153
Limestone, crystalline	147
Limestone, oolitic	138
Marble	156
Sandstone	137
Rubble stone masonry	156
Terra cotta, architectural:	
Voids filled	120
Voids unfilled	72
Timber, seasoned:	
Ash, commercial white	41
Cypress, southern	32
Fir, Douglas, Coast region	34
Oak, commercial reds and whites	45
Redwood	28
Spruce, red, white, and Sitka	28
Southern pine, short leaf	39
Southern pine, long leaf	48
Timber, hemlock	30

Table G-9
UNIT DESIGN DEAD LOADS FOR ROOF AND WALL COVERINGS

Roof and wall coverings	Pounds per square foot
Asphalt shingles	2
Cement asbestos shingles	4
Cement tile	16
Clay tile (for mortar add 10 lb):	
2-inch book tile	12
3-inch book tile	20
Roman	12
Ludowici	19
Composition:	10
Three-ply ready roofing	
Four-ply felt and gravel	1
Five-ply felt and gravel	5½
Copper or tin	6
Corrugated asbestos cement roofing	1
Fiber board, ½ inch	1-3
Formed sheet steel	(see manufacturer)
Formed steel decking	2
Gypsum sheathing, ½ inch	¾
Rigid insulation, ½ inch	3
Sheet lead	8
Skylight, metal frame, ⅜-inch wired glass	7
Slate 3/16-inch	10
Slate ¼ inch	20
Spanish tile	3
Wood sheathing, per inch thickness	3
Wood shingles	

Table G-10
UNIT DESIGN DEAD LOADS FOR SUSPENDED CEILINGS

Suspended ceilings	Pounds per square foot
Cement on wood lath	12
Cement on metal lath	15
Gypsum on wood or metal lath	10
Plaster on tile or concrete	5
Suspended metal lath and gypsum plaster	10
Suspended metal lath and cement plaster	15
Plaster on wood lath	8

Table G-11

UNIT DESIGN DEAD LOADS FOR UNPLASTERED WALLS AND PARTITIONS

Walls and partitions (unplastered)	Pounds per squarē foot
4 -inch clay brick, high absorption	34
4 -inch clay brick, medium absorption	39
4 -inch clay brick, low absorption	46
4 -inch sand/lime brick	38
4 -inch concrete brick, heavy aggregate	46
4 -inch concrete, light aggregate	33
8 -inch clay brick, high absorption	69
8 -inch clay brick, medium absorption	79
8 -inch clay brick, low absorption	89
8 -inch sand/lime brick	74
8 -inch concrete brick, heavy aggregate	89
8 -inch concrete brick, light aggregate	68
12 -inch common brick	120
12 -inch pressed brick	130
12 -inch sand/lime brick	105
12½ - inch concrete brick, heavy aggregate	130
12½ - inch concrete brick, light aggregate	98
17 -inch clay brick, high absorption	134
17 -inch clay brick, medium absorption	155
17 -inch clay brick, low absorption	173
17 -inch sand/lime brick	138
17 -inch concrete brick, heavy aggregate	174
17 -inch concrete brick, light aggregate	130
22 -inch clay brick, high absorption	168
22 -inch clay brick, medium absorption	194
22 -inch clay brick, low absorption	216
22 -inch sand/lime brick	173
22 -inch concrete brick, heavy aggregate	216
22 -inch concrete brick, light aggregate	160
4 -inch brick, 4 inch load bearing structural clay - tile backing	60
4 -inch brick, 8 inch loadbearing structural clay - tile backing	75
8 -inch brick, 4 inch loadbearing structural clay - tile backing	102
8 -inch combination brick and concrete block	72
12 -inch combination brick and concrete block	90
8 -inch loadbearing structural clay tile	42
12 -inch loadbearing structural clay tile	58
8 -inch concrete block, heavy aggregate	55
12 -inch concrete block, heavy aggregate	85
8 -inch concrete block, light aggregate	38
12 -inch concrete block, light aggregate	55
2 -inch furring tile, one side of masonry wall, - add to above figures	12
4 -inch hollow concrete block - stone aggregate	30
-lightweight	20
6 -inch hollow concrete block - stone aggregate	42
-lightweight	30
8 -inch hollow concrete block	55
-lightweight	38
10 -inch hollow concrete block - stone aggregate	62
-lightweight	46
12 -inch hollow concrete block - stone aggregate	85
-lightweight	55
4 -inch solid concrete block - stone aggregate	45
-lightweight	34
6 -solid concrete block - stone aggregate	50
-lightweight	37

Table G-11 (continued)
UNIT DESIGN DEAD LOADS FOR UNPLASTERED WALLS AND PARTITIONS

Walls and partitions (unplastered)	Pounds per square foot
8 -inch solid concrete block - stone aggregate	67
-lightweight	48
10 -inch solid concrete block - stone aggregate	84
-lightweight	52
12 -inch concrete block - stone aggregate	108
-lightweight	72
4 -inch loadbearing clay tile	24
6 -inch loadbearing clay tile	36
2 -inch nonloadbearing clay tile	11
3 -inch nonloadbearing clay tile	18
4 -inch nonloadbearing clay tile	20
6 -inch nonloadbearing clay tile	30
8 -inch nonloadbearing clay tile	36
10 -inch nonloadbearing clay tile	40
4 -inch nonloadbearing hollow concrete block	20
6 -inch nonloadbearing hollow concrete block	30
8 -inch nonloadbearing hollow concrete block	40
T.C. 1½-inch split terra cotta furring	8
2 -inch split terra cotta furring	10
3 -inch split terra cotta furring	12
2 -inch hollow gypsum block	9.5
3 -inch hollow gypsum block	10
4 -inch hollow gypsum block	15
5 -inch hollow gypsum block	18
6 -inch hollow gypsum block	24
2 -inch solid gypsum block	12
3 -inch solid gypsum block	18
4 -inch solid gypsum block	24
2 -inch facing tile	15
4 -inch facing tile	25
6 -inch facing tile	38
2 -inch solid plaster	20
4 -inch solid plaster	32
4 -inch hollow plaster	22
Wood studs 2x4, unplastered	4
Wood studs 2x4, plastered one side	12
Wood studs 2x4, plastered two sides	20
4 -inch glass block	18

Table G-12
UNIT DESIGN DEAD LOADS FOR LATH AND PLASTER PARTITIONS

Lath and plaster partitions	Pounds per square foot
2 -inch solid cement on metal lath	25
2 -inch solid gypsum on metal lath	18
2 -inch solid gypsum on gypsum lath	18
2 -inch metal studs, gypsum and metal lath both sides	18
3 -inch metal studs, gypsum and metal lath both sides	19
4 -inch metal studs, gypsum and metal lath both sides	20
6 -inch wood studs, plaster and wood lath both sides	18
6 -inch wood studs, plaster and metal lath both sides	18
6 -inch wood studs, plaster and plaster boards both sides	18
6 -inch wood studs, unplastered gypsum board both sides (dry wall)	10

Table G-13
UNIT DESIGN DEAD LOADS FOR PLASTER WORK

Plaster Work	Pounds per square foot
Gypsum (one side)	5
Cement (one side)	10
Gypsum on wood lath	8
Gypsum on metal lath	8
Gypsum on plaster board or fiber board	8
Cement on wood lath	10
Cement on metal lath	10

APPENDIX H

HISTORIC STRUCTURES

Historic structures eligible for individual listing in the National Register of Historic Places, qualifying as totally preserved buildings (see 780 CMR 3409.0).

Acton	Faulkner Homestead, High Street
Agawam	Capt. Charles Leonard House, Main Street
Amesbury	Rocky Hill Meetinghouse, Portsmouth Road
Arlington	Fowle-Reed-Wyman House, 64 Old Mystic Street Jason Russell, 7 Jason Street Old Schwamb Mill, 17 Mill Lane
Barre	Barre Historical Society, Common Street
Barnstable	Barnstable Custom House, Route 6A
Bedford	Job Lane House, 295 North Road
Beverly	John Balch House, 448 Cabot Street Capt. John Cabot House, 117 Cabot Street Rev. John Hale House, 39 Hale Street
Boston	Gleason House, Beacon Street James Blake House, E. Cottage Street (Dor.) Clapp Houses, 105 Boston Street (Dor.) Loring-Greenough House, 12 South Street (JP) Old State House, 15 State Street Pierce House, 24 Oakten Avenue (Dor.) South End Historical Soc., 532 Mass. Avenue Isabella Stewart Gardner Museum, 280 The Fenway
Boxford	Holyoke-French House, Elm Street Sylvanius-Thayer Birthplace, 786 Washington St
Brookline	Edward Devotion House, 347 Harvard Street
Burlington	Francis Wyman House, Francis Wyman Road
Cambridge	Cooper-Frost-Austin House, 21 Linnaean St.
Charlton	Ryder Tavern, Stafford Street
Chelmsford	Old Chelmsford Garrison House, 105 Garrison Road
Chelsea	Gov. Bellingham-Cary House, 34 Parker Street
Cohasset	Caleb Lothrop House, 14 Summer Street
Cummington	William Cullen Bryant Homestead, Bryant Road
Danvers	Fowler House, 166 High Street Rebecca Nurse House Glen Magna House
Dennis	Josiah Dennis Manse, Nobscuset Road West Schoolhouse

Duxbury	Gershom Bradford House, 931 Tremont Street
	King Caesar House, King Caesar Road
	Nathaniel Winsor House, 479 Washington Street
Gloucester	Beauport, Eastern Pt. Blvd.
	Hammond Castle, 80 Hesperus Avenue
Hadley	Hadley Farm Museum, Russell Street
	Porter Phelps Huntinghouse, 130 River Drive
Haverhill	The Whittier House, 305 Whittier Road
Holyoke	Wisteriahurst, 238 Cabot Street
Ipswich	Castle Hill, Argilla Road
Lee	Merrell Tavern, Route 102
Lenox	Ventfort Hall, 104 Walker Street
Lexington	Buckman Tavern, 1 Bedford Street
	Sanderson House, 314 Massachusetts Ave.
	Monroe Tavern, 1332 Massachusetts Ave.
Lincoln	The Grange, Codman Road
Lowell	Whistler House, Worthen Street
Lynnfield	Meetinghouse
Medford	Peak House, 347 Main Street
Milton	Dr. Amos Holbrook House, 203 Adams Street
	Daniel Vose House, 1370 Canton Avenue
Nantucket	Whaling Museum, Broad Street
	Fire Hose Cart House, 8 Gardner Street
	Greater Light, 8 Howard Court
	Old Gaol, 15 Vestal Street
	1800 House, 4 Mill Street
	Old Mill, 50 Prospect Street
	Hawden House, 96 Main Street
	Nathaniel Macy House, 12 Liberty Street
	Thomas Macy Warehouse, 10 Straight Wharf
	Fair Street Museum, 7 Fair Street
	Quaker Meeting House, 7 Fair Street
New Bedford	Benjamin Rodman House, 50 North Second Street
New Salem	Whitaker-Clary House, Elm Street
Newbury	Tristram Coffin House, 16 High Road
	Spencer-Pierce-Little House, Little Lane
Newton	Jackson Homestead, 527 Washington Street
No. Andover	Parson Barnard House, Osgood Street
No. Easton	Old Colony Railroad Station, Oliver Street
Norwood	Fred Holland Day, 93 Bay Street
Orleans	French Cable Station, Cove Road

Oxford	Clara Barton Homestead, Clara Barton Road
Peabody	Gen. Gideon Foster House, 35 Washington Street
Pittsfield	Herman melville House, 78 Holmes Road
Plymouth	Plymouth Antiquarian Society, 126 Water Street
	Harlow Old Ft. House, 19 Sandwich Street
	Pilgrim Hall, 75 Court Street
	Richard Sparrow House, 42 Summer Street
Quincy	Adams Academy, 8 Adams
	Quincy Homestead, 34 Butler Street
	Josiah Quincy House, 20 Muirhead Street
Randolph	Johnathan Belcher House, 360 N. Main
Reading	Parker Tavern, 103 Washington Street
Rockport	Old Castle, Castle Lane
Salem	House of 7 Gables, 46-54 Turner Street
	Essex Institute, Essex Street
	The Norbone House
	Witch Museum
	Crowningshield Bently, Essex Street
	Gardner-Pingree House, 128 Essex Street
	Gedney House, 21 High Street
	Cox House, 19 High Street
Sandwich	Hoxie House, 18 Water Street
	Eldred House, 4 Water Street
	Wing Fort House, Spring Hill Road
Sheffield	Col. John Ashley House, Cooper Hill Road
Shrewsbury	Gen. Artemas Ward Homestead, Main Street
Springfield	Alexander House, State Street
	George Walter Vincent Smith Art Museum
Stockbridge	Naumkeag, Prospect Hill
Swansea	The Luther Store, 160 Old Warren Road
	The Martin House, 22 Stoney Hill Road
Taunton	Old Colony Historical Society, 66 Church Green
	Parson Capen House
Waltham	Robert Treat Paine House, 577 Beaver Street
Watertown	Edmund Fowle House, 26 Marshall Street
Wenham	Claflin-Richard House, 132 Main
West Springfield	Josiah Day House, 70 Park Street
Weston	Gold Ball Tavern, Old Post Road
Woburn	Loammi Baldwin Mansion, 2 Alfred Street
Wilmington	Harden Tavern, 436 Salem Street

Worcester Timothy Paine House, 140 Lincoln Street

National Historic Landmarks

Amesbury	John Greenleaf Whittier Home, 86 Friend Street
Boston	African Meeting House, 8 Smith Court Nichols House, 55 Mt. Vernon Street Brook Farm, 678 Baker Street (Rox.) Christ Church, 191 Salem Street Faneuil Hall, Dock Square 1st Harrison Gray Otis House, 141 Beacon Street Paul Revere House, 19 North Street
Concord	Ralph Waldo Emerson House, 28 Cambridge Tpk. The Old Manse Orchard House, 299 Lexington Road
Dedham	Fairbanks House
Deerfield	Old Deerfield Village Historic District
Hancock	Hancock Shaker Village
Harvard	Fruitlands, Prospect Street
Hingham	Old Ship Meetinghouse, Main Street
Ipswich	John Whipple House, 53 S. Main Street
Lexington	Hancock Clarke House, 35 Hancock Street
Marblehead	Jeremiah Lee House, Washington Street King Hooper Mansion, Hooper Street
Marshfield	Daniel Webster Law Office, Webster Street
Medford	Peter Tufts House, 350 Riverside Drive Isaac Royal House, 15 George Street
Milton	Capt. R. B. Forbes House, 215 Adams
Nantucket	Nantucket Historic District Jethro Coffin House, Sunset Hill
New Bedford	New Bedford Historic District
Newburyport	Caleb Cushing House, 98 High Street
Quincy	John Adams Birthplace, 133 Franklin Street John Quincy Adams Birthplace, 141 Franklin Street
Salem	Peabody Museum The Custom House, 178 Derby Street
Saugus	Scotch Boardman House, 117 Howard Street
Stockbridge	Chesterwood, Williamsville Road The Mission House, Main Street
Waltham	The Vale, Lyman Street

	Gore Place, 52 Gore Street
Woburn	Count Rumford Birthplace, 90 Elm Street
Worcester	American Antiquarian Society, 185 Salisbury Street

Historic structures determined eligible for listing in the National Register of Historic Places not qualifying as totally preserved buildings (see Partially preserved buildings, 780 CMR 3409.0). Refer to:

1. National Register of Historic Places,
   U.S. Federal Register, February 1, 1978, Part II.
2. National Register of Historic Place (additions). Contact the Massachusetts Historical Commission at the Massachusetts Archives Building, 220 Morrissey Boulevard, Boston, MA 02125.

Historic districts listed in the National Register of Historic Places. Refer to:

1. National Register of Historic Places, U.S. Federal Register, February 1, 1979, Part II.
2. National Register of Historic Place (additions). Contact the Massachusetts Historical Commission at the Massachusetts Archives Building, 220 Morrissey Boulevard, Boston, MA 02125.

Structures proposed for certification as partially preserved not listed in the national register of historic places. Refer to Massachusetts Historical Commission Inventory Forms.

Contact the Massachusetts Historical Commission at the Massachusetts Archives Building, 220 Morrissey Boulevard, Boston, MA 02125.

NON-TEXT PAGE

APPENDIX I

INDEPENDENT STRUCTURAL ENGINEER REVIEW

I-1 Primary structure: For the purposes of the independent structural engineering review, the primary structure shall be defined as the structural frame, the load supporting parts of floors, roofs, and walls, and the foundations. Cladding, cladding framing, stairs, equipment supports, ceiling supports, non-load bearing partitions, and railings are excluded from this definition of primary structure.

I-2 Reviewing engineer: The reviewing engineer shall be engaged by the owner.

I-2.1 Qualifications: The reviewing engineer shall be a registered professional engineer, registered in Massachusetts, qualified by experience and training and who shall have had structural design experience with buildings or structures similar to that covered by the application for the building permit. The reviewing engineer shall be impartial, and shall be independent of the architect of record, structural engineer of record, and contractors and suppliers who will be involved in the construction of the structure.

I-3 Criteria for review: The reviewing engineer shall review the plans and specifications submitted with the application for the building permit for compliance with the structural and foundation design provisions of the Code. The reviewing engineer shall perform the following tasks:

1. Check to assure that the design loads conform with 780 CMR;
2. Check that other design criteria, and design assumptions, conform to 780 CMR and are in accordance with accepted engineering practice;
3. Review geotechnical and other engineering investigations that are related to the structural design to determine if the design properly incorporates the results and recommendations of the investigations;
4. Check that the organization of the structure is conceptually correct ; and
5. Make independent calculations for a representative fraction of systems, members, and details to check their adequacy. The number of representative systems, members, and details shall be sufficient to form a basis for the reviewer's conclusions.

I-3.1 Structural Calculations: The structural calculations prepared by the structural engineer of record shall be submitted to the reviewing engineer, upon the reviewing engineer's request, for his or her reference only. The reviewing engineer shall not be obligated to review or check these calculations. If the design criteria and design assumptions are not shown on the drawings or in the computations, the structural engineer of record shall provide a statement of these criteria and assumptions for the review.

I-4 Structural engineer of record: The structural engineer of record shall retain sole responsibility for the structural design, and the activities and reports of the reviewing engineer shall not relieve the structural engineer of record of this responsibility.

I-5 Report and follow-up:

1. The reviewing engineer shall prepare a report to the building official stating whether or not the structural design shown on the drawings and the specifications conform with the structural and foundation requirements of 780 CMR. Said report shall be based on the review as prescribed in this appendix and shall include a summary of all deficiencies, if any, which cannot be resolved with the structural engineer of record.
2. The structural engineer of record shall review the report of the reviewing engineer, and notify the building official in writing, whether or not he agrees with or disputes the conclusions and recommendations of the reviewing engineer.
3. Unresolved disputes between the structural engineer of record and the reviewing engineer shall be submitted by the building official, the owner, the structural engineer of record or the reviewing engineer to the Structural Peer Review Advisory Board for resolution.
4. Any changes to the structural design subsequent to the original submission of the plans and specifications shall be shown on revised drawings and specifications, submitted with an amendment to the application for permit. The reviewing engineer shall review the changes on the revised drawings and specifications, and, if the original report does not account for the changes in said drawings and specifications, a supplementary report relating to the changes and prepared by the reviewing engineer shall be made to the building official.

I-6 Foundation permits: When the plans and specifications are partially complete and an application is made for a foundation permit, the reviewing engineer may review the foundation plans and specifications on a conditional basis, provided that the reviewing engineer is given sufficient documentation so that he can perform Appendix I-3 Tasks 1, 2, 3, and 4 for the whole structure, and so that he can perform Appendix I-3 Task 5 for that part of the foundation covered by the application for foundation permit. The reviewing engineer shall prepare a report on that part of the foundation covered by the application for foundation permit, as prescribed in Appendix I-5, stating all conditions upon which the report is based. When the reviewing engineer reviews the completed plans and specifications as prescribed in Appendix I-3, the reviewing engineer shall reperform Tasks 1, 2, 3, and 4, as necessary, to include all the revisions to the design subsequent to the application for the foundation permit.

APPENDIX J

ENERGY CONSERVATION FOR NEW CONSTRUCTION LOW-RISE RESIDENTIAL BUILDINGS

(780 CMR Appendix J is based upon the Council of American Building Officials Model Energy Code 1995 Edition.)

780 CMR J1.0 ADMINISTRATION AND ENFORCEMENT

J1.1 Scope and General Requirements:

J1.1.1 Title: Appendix J reflects the technical requirements of the Model Energy Code 1995 Edition, but also contains material which reflects the unique requirements of Massachusetts.

J1.1.2 Scope: 780 CMR Appendix J sets forth minimum requirements for the design and construction of new residential occupancy buildings and additions to existing residential occupancy buildings three stories or less in height by regulating the design and construction of building envelopes for adequate thermal resistance and low air leakage, and by the design, selection, and installation of mechanical, electrical, and service water heating systems and equipment to enable efficient use of energy. It is intended that these provisions provide flexibility to permit the use of innovative approaches and techniques to achieve effective utilization of energy. 780 CMR Appendix J is not intended to abridge safety, health, or environmental requirements under other applicable code sections or ordinances.

Note: For alterations to existing buildings, see 780 CMR J1.1.2.3 and Chapter 34.

J1.1.2.1 Building Types:

J1.1.2.1.1 Group R residential buildings: New construction buildings, or new portions thereof, that must comply with the requirements of Appendix J are:

1. Detached one- and two-family dwellings (Use Groups R-4 or R-5 in 780 CMR 310); and,
2. All other residential buildings, three stories or less in height (Use Groups R-2, R-3, or R-5 in 780 CMR 310). Note that Use Group R-1 buildings are to be treated as *commercial buildings*.

J1.1.2.1.2 Other Buildings: New construction buildings and structures not included in 780 CMR J1.1.2.1.1. shall be classified as Commercial/High-Rise Buildings and shall be designed and constructed to comply with the requirements of 780 CMR 13.

J1.1.2.2 Exempt buildings: The following buildings or structures shall be exempt from the requirements of 780 CMR Appendix J:

1. Buildings and structures or portions thereof whose peak design rate of energy usage is less than 3.4 Btu/h per square foot (10.7 W/m^2) or 1.0 watt per square foot (10.7 W/m^2) of floor area for all purposes;
2. Greenhouses that are free-standing, or attached to a building and separated by a wall having the same thermal value as an exterior wall, and provided with a separate temperature control system;
3. Buildings with less than 100 square feet of gross floor area, and;
4. Buildings and structures or portions thereof which are neither heated nor cooled.

J1.1.2.3 Application to existing buildings:

J1.1.2.3.1 Additions to existing buildings: Additions to existing buildings or structures shall comply with one of the applicable criteria below:

1. The new addition, by itself, shall conform to the applicable provisions of Appendix J, **or;**
2. The new addition plus the existing building/dwelling unit may be considered together to ensure compliance with all applicable provisions of Appendix J, **or;**
3. Additions that are open to or separated by an exterior wall from the existing house/ dwelling unit shall meet the prescriptive envelope component criteria of Table J1.1.2.3.1. The total area (rough opening or unit dimensions) of glazed fenestration products (windows, skylights, and glazed portion of doors) shall not exceed 40% of the gross wall and gross ceiling area of the addition combined. If any individual fenestration component exceeds the maximum U-value listed in Table J1.1.2.3.1, then the area-weighted average U-value for all fenestration components must be less than or equal to the listed value. The R-value requirements for opaque thermal envelope

components indicate insulation products (cavity and/or insulating sheathing), and shall be equal to or exceed the applicable listed values found in Table J1.1.2.3.1. If such additions are separated from the main house by a wall and are conditioned, then a readily accessible manual or automatic means shall be provided to partially restrict or shut off the heating and/or cooling input to the addition space. That portion of a wall that separates the addition from the existing building/dwelling unit, if an existing exterior wall, shall be allowed to remain and neither that portion of said wall or any fenestration within said portion of wall common to the addition need comply with the thermal envelope requirements of Appendix J.

TABLE J1.1.2.3.1
Prescriptive Envelope Component Criteria Additions to Existing Low-Rise Residential Buildings

MAXIMUM	MINIMUM				
Fenestration U-value	Ceiling R-Value	Wall R-Value	Floor R-Value	Basement Wall R-Value	Slab Perimeter R-Value and Depth
0.39	R-37[1]	R-13	R-19	R-10	R-10, 4 ft

[1] R-30 ceiling insulation may be used in place of R-37 if the insulation achieves the full R-value over the entire ceiling area (i.e. - not compressed over exterior walls, and including any access openings.)

Exception: *Sunroom* Additions / Consumer Notification: *Sunrooms*, as defined in 780 CMR Appendix J2.0 DEFINITIONS, shall be exempt from the compliance requirements set forth in 780 CMR J1.1.2.3.1 and J1.1.3 provided that the actual property owner (not the owner's agent or representative) of the structure onto which the *sunroom* addition is being made, provides a signed copy of the Sunroom "CONSUMER INFORMATION FORM" (found in 780 CMR, Appendix B) to the Building Department. This signed "CONSUMER INFORMATION FORM" shall be submitted to the building official as a requirement of building permit issuance, and shall remain as part of the construction documents. If such *sunroom* additions are separated from the main house by a wall and are conditioned spaces, then a readily accessible manual or automatic means shall be provided to partially restrict or shut off the heating and/or cooling input to the *sunroom* addition space. That portion of a wall that separates the *sunroom* addition from the existing building/dwelling unit, if an existing exterior wall, shall be allowed to remain and neither that portion of said wall or any fenestration within said portion and common to the *sunroom* addition, need comply with the thermal envelope requirements of Appendix J.

J1.1.2.3.2 Historic buildings: Historic buildings, as defined in 780 CMR 3409, are exempt from Appendix J.

J1.1.2.3.3 Change of occupancy: A change in the occupancy or change in use of an existing building or structure shall be permitted, subject to the provisions of 780 CMR 3407.

J1.1.2.4 Mixed occupancy: When a building houses more than one occupancy, each portion of the building shall conform to the requirements for the occupancy housed therein. Where minor accessory uses do not occupy more than 10% of the area of any floor of a building, the major use shall be considered the building occupancy.

J1.1.3 Compliance: Compliance with Appendix J shall be determined by one of the following alternatives:

1. 780 CMR J5.0, Residential Building Design by Prescriptive Practice (or Default Package Approach) in which the U and R values are given for the thermal envelope. Additional requirements are stated in 780 CMR J4.0, or;
2. 780 CMR J6.0, Residential Building Design by Component Performance (or Manual Trade-off Approach) which allows trade-offs between building envelope components and heating and cooling equipment efficiencies to minimize cost. Additional requirements are stated in 780 CMR J4.0, or;
3. 780 CMR J7.0, Residential Building Design by MAS*check* Software which achieves similar results as the Manual Trade-off Approach. Additional requirements are stated in 780 CMR J4.0, or;
4. 780 CMR J8.0, the Systems Approach or Total Energy Analysis for the entire building and its energy using sub-systems, or;
5. 780 CMR J9.0, Buildings Utilizing Renewable Energy Resources.
6. 780 CMR J11.0, a Home Energy Rating issued for the home with a score of 83.0 or more points

J1.2 Construction Documents:

J1.2.1 General: Construction documents including necessary computations shall be submitted to the building official as part of the building permit application process. Such construction documents shall indicate conformance with 780 CMR J1.2 and other applicable sections of 780 CMR, and in accordance with 780 CMR 110.

J1.2.2 Details: The construction documents shall show in sufficient detail pertinent data and features of the building project and the equipment and systems as herein governed, including, but not limited to, design criteria, exterior envelope component materials, *U*-values of the envelope systems, *R*-values of insulating materials, size and type of apparatus and equipment, equipment and systems controls, energy calculations if applicable, and other pertinent data to indicate conformance with the requirements of the Building Code.

When HVAC equipment sizing information is not available at the time of initial building permit application, such information shall be submitted prior to the installation of said equipment, and supporting calculations shall demonstrate compliance with 780 CMR J4.4. Installed equipment must meet or exceed the efficiency rating listed in the submitted construction documents.

J1.3 Inspections

J1.3.1 General: Construction or work for which a permit is required shall be subject to 780 CMR 111 and 115.

J1.4 Precedence: When provisions of 780 CMR Appendix J and a section of a referenced standard specify different materials, methods of construction, or other requirements, the explicit provisions of 780 CMR shall govern.

J1.5 Materials and Equipment

J1.5.1 Identification:

J1.5.1.1 General: Materials and equipment shall be identified in a manner that will allow a determination of their compliance with the applicable provisions of Appendix J.

J1.5.1.2 Building envelope insulation: A thermal resistance (*R*) identification mark shall be required on each piece of building envelope insulation 12 inches (305 mm) or greater in width.

Alternatively, the insulation installer shall provide a signed and dated certification for the insulation installed in each element of the building envelope, listing the type of insulation, the manufacturer and the *R*-value. For blown-in or sprayed insulation, the installer shall also provide the initial installed thickness, the settled thickness, the coverage area and number of bags installed. The installer shall post the certification in a conspicuous place on the job site.

J1.5.1.3 Insulation installation: Roof-ceiling, floor and wall cavity insulation shall be installed in accordance with manufacturer's instructions, and in a manner which will permit inspection of the manufacturer's *R*-value identification mark.

Alternatively, the thickness of roof-ceiling insulation that is either blown or sprayed shall be identified by thickness markers that are labeled in inches installed at least one for every 300 square feet (28 m^2) through the attic space. The markers shall be affixed to the trusses or joists, and marked with the minimum initial installed thickness and the minimum settled thickness with numbers at least 1.0 inch (25 mm) in height. Each marker shall face the attic access. The thickness of installed insulation shall meet or exceed the minimum initial installed thickness shown by the marker.

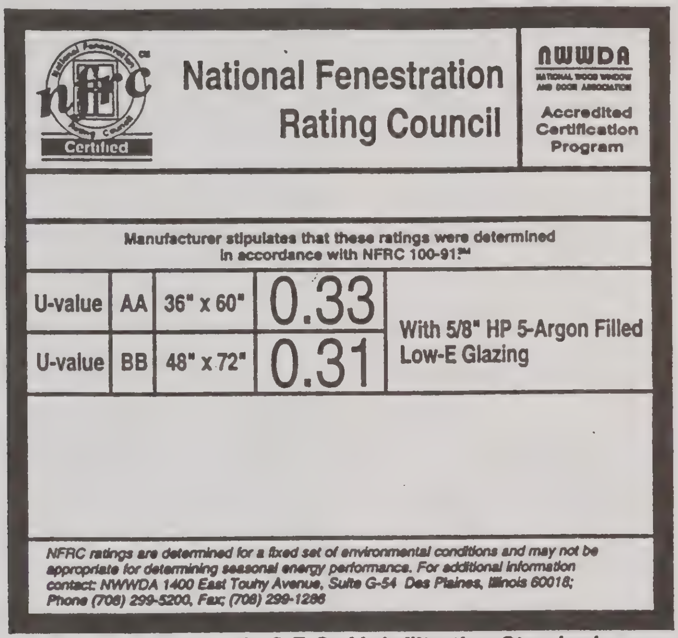
J1.5.2 Maintenance information: Required regular maintenance actions shall be clearly stated and incorporated on a readily accessible label on the equipment or made otherwise available for permanent reference. Such label may be limited to identifying, by title or publication number, the operation and maintenance manual for that particular model and type of product. Maintenance instructions shall be furnished for equipment which requires preventive maintenance for efficient operation.

J1.5.3 Fenestration product rating, certification and labeling: U-values of fenestration products (windows, doors and skylights) shall be determined in accordance with the NFRC 100, as listed in Appendix A, and labeled (see Figure J1.5.3 below) and certified by the manufacturer. Such certified and labeled values shall be accepted for purposes of determining compliance with the building envelope requirements of Appendix J.

Note 1: NFRC certification and labeling requirements take effect January 1, 1999. Prior to January 1, 1999, window, door, and skylight U-values may be assigned using manufacturers' calculations or the default values in Tables J1.5.3a and J1.5.3b.

Note 2: After January 1, 1999, when a manufacturer of windows, glazed and unglazed doors or skylights has not determined product U-value in accordance with J1.5.3for a particular product line, compliance with the building envelope requirements of Appendix J shall be determined only by assigning such products a default U-value in accordance with Tables J1.5.3a and J1.5.3b. Product features must be verifiable for the product to qualify for the default value associated with those features. Where the existence of a particular feature cannot be determined with reasonable certainty, the product shall not receive credit for that feature. Where a composite of materials from two different product types are used, the product shall be assigned the higher U-value.

FIGURE J1.5.3



National Fenestration Rating Council

NFRC Certified

NWWDA
NATIONAL WOOD WINDOW AND DOOR ASSOCIATION
Accredited Certification Program

Manufacturer stipulates that these ratings were determined in accordance with NFRC 100-91℠

U-value	AA	36" x 60"	0.33	With 5/8" HP 5-Argon Filled Low-E Glazing
U-value	BB	48" x 72"	0.31	

NFRC ratings are determined for a fixed set of environmental conditions and may not be appropriate for determining seasonal energy performance. For additional information contact: NWWDA 1400 East Touhy Avenue, Suite G-54 Des Plaines, Illinois 60018; Phone (708) 299-5200, Fax; (708) 299-1286

Meets or exceeds C.E.C. Air Infiltration Standards

Table J1.5.3a
U-value Default Table for Windows, Glazed Doors, and Skylights

	Single Glazed	Double Glazed and Single Glazed with Storm
Metal Without Thermal Break		
Operable	1.30	0.87
Fixed	1.17	0.69
Door	1.26	0.80
Skylight	1.92	1.30
Metal with Thermal Break		
Operable	1.07	0.67
Fixed	1.11	0.63
Door	1.10	0.66
Skylight	1.93	1.13
Metal-Clad Wood		
Operable	0.98	0.60
Fixed	1.05	0.58
Door	0.99	0.57
Skylight	1.50	0.88
Wood/Vinyl		
Operable	0.94	0.56
Fixed	1.04	0.57
Door	0.98	0.56
Skylight	1.47	0.85

For SI: 1 inch = 25.4 mm.
Glass block assemblies shall have a U-value of 0.60.

Table J1.5.3b
U-value Default Table for Non-glazed Doors

	With Foam Core	Without Foam Core
Steel Doors (1-¾ Inches Thick)	0.35	0.60
	Without Storm Door	With Storm Door
Wood Doors (1-¾ Inches Thick)		
Panel with 7/16-inch panels	0.54	0.36
Hollow core flush	0.46	0.32
Panel with 1-⅛-inch panels	0.39	0.28
Solid core flush	0.30	0.26

For SI: 1 inch = 25.4 mm.

J1.6 Alternate Materials — Method of Construction, Design Or Insulating Systems: The provisions of Appendix J are not intended to prevent the use of any material, method of construction, design or insulating system not specifically prescribed herein, provided that such construction, design or insulating system has been approved, if necessary, by the BBRS as meeting the intent of Appendix J.

780 CMR J2.0 DEFINITIONS

780 CMR J2.1 General Definitions

J2.2 Meaning: Unless otherwise expressly stated, the following terms shall, for the purpose of 780 CMR Appendix J, have the meaning indicated in 780 CMR J2.0.

J2.3 Tense, gender and number: Words used in the present tense include the future; words used in the masculine gender include the feminine and neuter; the singular number includes the plural and the plural the singular.

J2.4 Terms not defined: Where terms are not defined, they shall have their ordinarily accepted meanings or such as the context may imply. Any terms relating to plumbing and electrical wiring shall have their terms as defined by the Regulations of the Commonwealth of Massachusetts pertaining to plumbing and electrical wiring.

ACCESSIBLE (AS APPLIED TO EQUIPMENT): Admitting close approach because not guarded by locked doors, elevation or other effective means (see "Readily accessible").

AIR CONDITIONING, COMFORT: The process of treating air so as to control simultaneously its temperature, humidity, cleanliness, and distribution to meet requirements of the conditioned space.

AIR TRANSPORT FACTOR: The ratio of the rate of useful sensible heat removal from the conditioned space to the energy input to the supply and return fan motor(s), expressed in consistent units and under the designated operating conditions.

ANNUAL FUEL UTILIZATION EFFICIENCY (AFUE): The ratio of annual output energy to annual input energy which includes any non-heating season pilot input loss, and for gas or oil-fired furnaces or boilers, does not include electrical energy.

AUTOMATIC: Self-acting, operating by its own mechanism when actuated by some impersonal influence, as, for example, a change in current strength, pressure, temperature or mechanical configuration (see "Manual").

BASEMENT WALL: The opaque portion of a wall which encloses one side of a basement and is partially or totally below grade.

BOILER CAPACITY: The rate of heat output in Btu/h (W) measured at the boiler outlet, at the design inlet and outlet conditions and rated fuel/energy input.

BUILDING ENVELOPE: The elements of a building which enclose conditioned spaces through which thermal energy may be transferred to or from the exterior or to or from spaces exempted by the provisions of 780 CMR J1.1.2.2.

BUILDING PROJECT: A building or group of buildings, including on-site energy conversion or electric-generating facilities, which utilize a single submittal for a construction permit or are within the boundary of a contiguous area under one ownership.

COEFFICIENT OF PERFORMANCE (COP)—COOLING: The ratio of the rate of heat removal to the rate of energy input in consistent units, for a complete cooling system or factory assembled equipment, as tested under a nationally recognized standard or designated operating conditions.

COEFFICIENT OF PERFORMANCE (COP)—HEAT PUMP—HEATING: The ratio of the rate of heat delivered to the rate of energy input, in consistent units, for a complete heat pump system under designated operating conditions. Supplemental heat shall not be considered when checking compliance with the heat pump equipment (COPs listed in the tables in 780 CMR J4.4).

COMFORT: The physical conditions represented in the area on a psychometric chart enclosing all those conditions described in Figure 1 in ASHRAE 55, as listed in Appendix A, as being comfortable.

COMMERCIAL BUILDINGS: For purposes of energy conservation, a commercial building is any building other than a *low-rise residential building,* as defined in 780 CMR J2.0.

CONDITIONED FLOOR AREA: The horizontal projection of that portion of interior space which is contained within exterior walls and which is conditioned directly or indirectly by an energy-using system.

CONDITIONED SPACE: Space within a building which is provided with positive heat supply (see definition), or which has heated and/or cooled air or surfaces, or where required, with humidification or dehumidification means so as to be capable of maintaining a space condition falling within the comfort zone set forth in ASHRAE 55, as listed in Appendix A.

COOLED SPACE: Space within a building which is provided with a positive cooling supply.

CRAWL SPACE WALL: The opaque portion of a wall which encloses a crawl space and is partially or totally below grade.

DEADBAND: The temperature range in which no heating or cooling is used.

DEGREE DAY, COOLING: A unit, based upon temperature difference and time, used in estimating cooling energy consumption. For any one day, when the mean temperature is more than 65°F (18°C), there are as many degree days as degrees Fahrenheit (Celsius) temperature difference between the mean temperature for the day and 65°F. (18°C.). Annual Cooling Degree Days (CDD) are the sum of the degree days over a calendar year.

DEGREE DAY, HEATING: A unit, based upon temperature difference and time, used in estimating fuel consumption and specifying nominal heating load of a building in winter. For any one day, when the mean temperature is less than 65°F (18°C), there exists as many degree days as there are Fahrenheit degrees difference in temperature between the mean temperature for the day and 65°F (18°C).

DWELLING UNIT: A single housekeeping unit comprised of one or more rooms providing complete independent living facilities for one or more persons, including permanent provisions for living, sleeping, eating, cooking and sanitation.

EFFICIENCY, HVAC SYSTEM: The ratio of useful energy output (at the point of use) to the energy input in consistent units for a designated time period, expressed in percent.

ENERGY: The capacity for doing work taking a number of forms which may be transformed from one into another, such as thermal (heat), mechanical (work), electrical and chemical in customary units, measured in kilowatt-hours (kWh) or British thermal units (Btu) (J) (see "New Energy").

ENERGY EFFICIENCY RATIO (EER): The ratio of net equipment cooling capacity in Btu/h to total rate of electric input in watts (W) under designated operating conditions. If the output capacity in Btu/h is converted to watts (to create consistent units) the result is equal to the cooling COP (EER 3.41 = COP.) See also Coefficient of Performance.

ENERGY, RECOVERED: See "Recovered energy."

EXISTING BUILDINGS: For purposes of energy conservation, and existing building which has been legally occupied and/or used for a period of at least five years. (Also see 780 CMR 2.0 and 780 CMR 3400.3.1.)

EXTERIOR ENVELOPE: See "Building envelope."

FURNACE, DUCT: A furnace normally installed in distribution ducts of air conditioning systems to supply warm air for heating and which depends on a blower not furnished as part of the duct furnace for air circulation.

FURNACE, WARM AIR: A self-contained, indirect-fired or electrically heated furnace that supplies heated air through ducts to spaces that require it.

GLAZING AREA: Interior surface area of all glazed surfaces (such as windows, sliding glass doors, skylights, etc.), sash, curbing, jambs, or other framing elements that enclose conditioned spaces.

GROSS AREA OF EXTERIOR WALLS: The normal projection of the building envelope wall area bounding interior space which is conditioned by an energy-using system including opaque wall, window and door area.

The gross area of exterior walls consists of all opaque wall areas, including between floor spandrels, peripheral edges of floors, roof and basement knee walls, walls enclosing a mansard roof, window areas including sash, and door areas when such surfaces are exposed to outdoor air, unconditioned spaces, or mechanically cooled space, including interstitial areas between two such spaces. For each basement wall that encloses heated space, if the average below-grade area is less than 50% of the total area for that wall, including openings, the entire wall, including the below-grade portion is included as part of the gross area of exterior walls. Non-opaque areas (windows, doors, etc.) of all basement walls are included in the gross area of exterior walls. (Note: if the basement is not heated space, and if the basement ceiling is insulated, then the basement walls are not included in the gross area of exterior walls.

GROSS FLOOR AREA: The sum of the areas of the several floors of the building, including basements, cellars, mezzanine and intermediate floored tiers and penthouses of headroom height, measured from the exterior faces of exterior walls or from the center line of walls separating buildings, but excluding:

1. Covered walkways, open roofed-over areas, porches and similar spaces.
2. Pipe trenches, exterior terraces or steps, chimneys, roof overhangs and similar features.

GROUP R RESIDENTIAL BUILDINGS: For the purpose of Appendix J, Group R residential buildings include:

1. Detached one and two family dwellings (Use Groups R-4 and R-5 in 780 CMR 310); and,
2. All other residential buildings, three stories or less in height (Use Groups R-1, R-2, R-3, R-5 in 780 CMR 310).

HEAT: The form of energy that is transferred by virtue of a temperature difference or a change in state of a material.

HEATED SLAB: Slab-on-grade construction in which the heating elements or hot air distribution system is in contact with or placed within the slab or the sub-grade.

HEATED SPACE: Space within a building which is provided with a positive heat supply. Space within a basement with registers or heating devices designed to supply heat to a basement space shall automatically define that space as heated space.

HEATING SEASONAL PERFORMANCE FACTOR (HSPF): The total heating output of a heat pump during its normal annual usage period for heating, in Btu, divided by the total electric energy input during the same period, in watt hours, as determined by Code of Federal Regulations, 10 CFR Part 430, Subpart B, Test procedures and based on Region 4, as listed in Appendix A.

HUMIDISTAT: A regulatory device, actuated by changes in humidity, used for automatic control of relative humidity.

HVAC: Heating, ventilating, and air conditioning.

HVAC SYSTEM: The equipment, distribution network, and terminals that provide either collectively or individually the processes of heating, ventilating, or air conditioning to a building.

HVAC SYSTEM COMPONENTS: HVAC system components provide, in one or more factory-assembled packages, means for chilling and/or heating water with controlled temperature for delivery to terminal units serving the conditioned spaces of the building. Types of HVAC system components include, but are not limited to, water chiller packages, reciprocating condensing units and water source (hydronic) heat pumps (see "HVAC system equipment").

HVAC SYSTEM EFFICIENCY: See "Efficiency, HVAC system."

HVAC SYSTEM EQUIPMENT: HVAC system equipment provides, in one (single package) or more (split system) factory-assembled packages, means for air circulation, air cleaning, air cooling with controlled temperature and dehumidification, and, optionally, either alone or in combination with a heating plant, the functions of heating and humidifying. The cooling function may be either electrically or heat operated and the refrigerant condenser may be air, water or evaporatively cooled. Where the equipment is provided in more than one package, the separate packages shall by designed by the manufacturer to be used together. The equipment may provide the heating function as a heat pump or by the use of electric or fossil-fuel-fired elements. (The word "equipment" used without modifying adjective may, in accordance with common industry usage, apply either to HVAC system equipment or HVAC system components.)

INFILTRATION: The uncontrolled inward air leakage through cracks and interstices in any building element and around windows and doors of a building caused by the pressure effects of wind and/or the effect of differences in the indoor and outdoor air density.

INTEGRATED PART-LOAD VALUE (IPLV): A single number figure of merit based on part-load EER or COP expressing part-load efficiency for air-conditioning and heat pump equipment on the basis of weighted operation at various load capacities for the equipment.

LOW-RISE RESIDENTIAL BUILDINGS: Residential occupancy buildings (R-2, R-3, R-4, or R-5) three stories or less in height. (Exception: For purposes of energy conservation, R-1 use group buildings shall be treated as *commercial buildings* as defined in 780 CMR J2.0.)

MANUAL: Capable of being operated by personal intervention (see "Automatic").

MULTIFAMILY DWELLING: A building containing three or more dwelling units.

NET AREA OF EXTERIOR WALLS: The gross area of exterior walls, minus the total rough opening area of all windows and doors set in the exterior walls.

NEW ENERGY: Energy, other than recovered energy, utilized for the purpose of heating or cooling (see "Energy").

OPAQUE AREAS: All exposed areas of a building envelope which enclose conditioned space, except openings for windows, skylights, doors and building service systems.

OUTDOOR AIR: Air taken from the outdoors, (i.e. - not previously circulated through the HVAC system.)

PACKAGED TERMINAL AIR CONDITIONER (PTAC): A factory-selected wall sleeve and separate unencased combination of heating and cooling components, assemblies or sections (intended for mounting through the wall to serve a single room or zone). It includes heating capability by hot water, steam, or electricity. (For the complete technical definition, see ARI Standard 310 listed in Appendix A.)

PACKAGED TERMINAL HEAT PUMP: A PTAC capable of using the refrigeration system in reverse cycle or heat pump mode to provide heat. (For complete technical definition, see ARI 380 listed in Appendix A.)

POSITIVE COOLING SUPPLY: Mechanical cooling deliberately supplied to a space, such as through a supply register. Also, mechanical cooling indirectly supplied to a space through uninsulated surfaces of space-cooling components, such as evaporator coil cases and cooling distribution systems which continually maintain air temperatures within the space of 85°F (29°C) or lower during normal operation. To be considered exempt from inclusion in this definition, such surfaces shall comply with the insulation requirements of Appendix J4.

POSITIVE HEAT SUPPLY: Heat deliberately supplied to a space by design, such as a supply register, radiator or heating element. Also, heat indirectly supplied to a space through uninsulated surfaces of service water heaters and space heating components, such as furnaces, boilers and heating and cooling distribution systems which continually maintain air temperature within the space of 50°F (10°C) or higher during normal operation. To be considered exempt from inclusion in this definition, such surfaces shall comply with the insulation requirements of Appendix J4.

READILY ACCESSIBLE: Capable of being reached quickly for operation, renewal or inspections, without requiring those to whom ready access is requisite to climb over or remove obstacles or to resort to portable ladders or access equipment (see "Accessible).

RECOOLING: The removal of heat by sensible cooling of the supply air (directly or indirectly) that has been previously heated above the temperature to which the air is to be supplied to the conditioned space for proper control of the temperature of that space.

RECOVERED ENERGY: Energy utilized which would otherwise be wasted (i.e., not contribute to a desired end use) from an energy utilization system.

REHEAT: The application of sensible heat to supply air that has been previously cooled below the temperature of the conditioned space by either mechanical refrigeration or the introduction of outdoor air to provide cooling.

RENEWABLE ENERGY SOURCES: Sources of energy (excluding minerals and solid fuels) derived from incoming solar radiation, including natural daylighting and photosynthetic processes; from phenomena resulting therefrom, including wind, waves and tides, lake or pond thermal differences; and from the internal heat of the earth, including nocturnal thermal exchanges.

RESET: Adjustment of the set point of a control instrument to a higher or lower value automatically or manually to conserve energy.

RESIDENTIAL BUILDINGS: For the purposes of Appendix J, Group R residential buildings include:

1. Type I (R-4, R-5): Detached one and two family dwellings; and,
2. Type II (R-1, R-2, R-3, R-5): All other residential buildings, three stories or less in height.

ROOF ASSEMBLY: A roof assembly shall be considered as all components of the roof/ceiling envelope through which heat flows, thus creating a building transmission heat loss or gain, where such assembly is exposed to outdoor air and encloses a heated or mechanically cooled space.

The gross area of a roof assembly consists of the total interior surface of such assembly, including skylights exposed to the heated or mechanically cooled space.

ROOM AIR CONDITIONER: An encased assembly designed as a unit for mounting in a window or through a wall, or as a console. It is designed primarily to provide free delivery of conditioned air to an enclosed space, room or zone. It includes a prime source of refrigeration for cooling and dehumidification and means for circulating and cleaning air, and may also include means for ventilating and heating.

SASH CRACK: The sum of all perimeters of all window sashes, based on overall dimensions of such parts, expressed in linear feet. If a portion of one sash perimeter overlaps a portion of another sash perimeter, only count the length of the overlapping portions once.

SEASONAL ENERGY EFFICIENCY RATIO (SEER): The total cooling output of an air conditioner during its normal annual usage period for cooling, in Btu/h (W), divided by the total electric energy input during the same period, in watt-hours, as determined by Code of Federal Regulations, 10 CFR Part 430, Subpart B, Test procedures, as listed in Appendix A.

SEQUENCE: A consecutive series of operations.

SERVICE SYSTEMS: All energy-using systems in a building that are operated to provide services for the occupants or processes housed therein, including HVAC, service water heating, illumination, transportation, cooking or food preparation, laundering and similar functions.

SERVICE WATER HEATING: Supply of hot water for purposes other than space heating.

SLAB-ON-GRADE FLOOR INSULATION: Insulation around the perimeter of the floor slab or its supporting foundation when the top edge of the floor perimeter slab is above the finished grade or 12 inches (305 mm) or less below the finished grade.

SOLAR ENERGY SOURCE: Source of natural daylighting and of thermal, chemical or electrical energy derived directly from conversion of incident solar radiation.

SUNROOM: An *addition* to an existing building/dwelling unit where the total area (rough opening or unit dimensions) of glazed fenestration products of said *addition* exceeds 40% of the combined gross wall and ceiling area of the *addition*.

SYSTEM: A combination of central or terminal equipment or components and/or controls, accessories, interconnecting means, and terminal devices by which energy is transformed so as to perform a specific function, such as HVAC, service water heating or illumination.

THERMAL CONDUCTANCE (C): Time rate of heat flow through a body (frequently per unit area) from one of its bounding surfaces to the other for a unit temperature difference between the two surfaces, under steady conditions (Btu/h·ft.^{2}·°F) [W/(m^{2}·k)].

THERMAL RESISTANCE (*R*): The reciprocal of thermal conductance (h·ft.^{2}·°F/Btu) [(m^{2}·K)/W].

THERMAL RESISTANCE, OVERALL (R_o): The reciprocal of overall thermal conductance (h·ft.^{2}·°F/Btu) [(m^{2}·k)/W]. The overall thermal resistance of the gross area or individual component of the exterior building envelope (roof/ceiling, exterior wall, floor, crawl space wall, foundation, window, skylight, door, or opaque wall, etc.) which includes the weighted *R*-values of the component assemblies (such as air-film, insulation, drywall, framing, glazing, etc.).

THERMAL TRANSMITTANCE (*U*): The coefficient of heat transmission (air to air). It is the time rate of heat flow per unit area and unit temperature difference between the warm side and cold side air films (Btu/h· ft.^{2}·°F) [W/(m^{2}·k)]. The *U*-value applies to combinations of different materials used in series along the heat flow path, single materials that comprise a building section, cavity air spaces and surface air films on both sides of a building element. The term **F-value** applies to U properties for concrete slabs.

THERMAL TRANSMITTANCE, OVERALL (U_o): The overall (average) heat transmission of a gross area of the exterior building envelope (Btu/h·ft.^{2}·°F) [W/(m^{2}·k)]. The U_o value applies to the combined effect of the time rate of heat flow through the various parallel paths, such as windows, doors and opaque construction areas, comprising the gross area of one or more exterior building components, such as walls, floors or roof/ceilings.

THERMOSTAT: An automatic control device actuated by temperature and designed to be responsive to temperature.

UNITARY COOLING AND HEATING EQUIPMENT: One or more factory-made assemblies which include an evaporator or cooling coil, a compressor and condenser combination, and may include a heating function as well. When heating and cooling equipment is provided in more than one assembly, the separate assemblies shall be designed to be used together.

UNITARY HEAT PUMP: One or more factory-made assemblies which include an indoor conditioning coil, compressor(s) and outdoor coil or refrigerant-to-water heat exchanger, including means to provide both heating and cooling functions. When heat pump equipment is provided in more than one assembly, the separate assemblies shall be designed to be used together.

VENTILATION: The process of supplying or removing air by natural or mechanical means to or from any space. Such air may or may not have been conditioned.

VENTILATION AIR: That portion of supply air which comes from outside (outdoors) plus any recirculated air that has been treated to maintain the desired quality of air within a designated space. (See BOCA Mechanical Code, as listed in Appendix A, 780 CMR J3, and definition of "Outdoor air.")

WATER HEATER, NON-STORAGE: A water heater with an input rating of at least 4,000 Btu/h per gallon (310 W/L) stored water and a storage capacity of less than ten gallons (38 L).

WATER HEATER, STORAGE: A water heater with an input rating of less than 4,000 Btu/h per gallon (310 W/L) of stored water or storage capacity of at least ten gallons (38 L).

ZONE: A space or group of spaces within a building with heating and/or cooling requirements sufficiently similar so that comfort conditions can be maintained throughout by a single controlling device.

780 CMR J3.0 DESIGN CONDITIONS

J3.1 Design Criteria:

J3.1.1 General: The criteria of 780 CMR J3.0 establish the design conditions for use with 780 CMR J5, J6, J7, J8 and J9.

J3.2 Thermal Design Parameters

J3.2.1 Exterior design conditions. As applicable, the design parameters in Table J3.2.1 shall be used for calculations required under Appendix J.

TABLE J3.2.1
Exterior Design Conditions
Heating Degree Days Base 65 (HDD_{65})

	Outside Ambient			
Location	Heating Degrees (°F) Winter[1]	Cooling Degrees (°F) Dry Bulb Summer[1]	Cooling Degrees (°F) Wet Bulb Summer[1]	Heating Degree Days[2] Base 65
Boston	9	88	74	5641
Clinton	2	87	73	6698
Fall River	9	84	73	5774
Framingham	6	86	73	6262
Gloucester	5	86	74	-
Greenfield	-2	85	73	-
Lawrence	0	87	74	6322
Lowell	1	88	74	6339
New Bedford	9	82	73	5426
Pittsfield	-3	84	72	7578
Springfield	0	87	73	5754
Taunton	9	86	74	6346
Worcester	4	84	72	6979

For SI: °F.=1.8°C. + 32.

[1] The outdoor design temperature shall be selected from the columns of 97½% values for winter and 2½% values for summer from tables in the ASHRAE Handbook of Fundamentals, as listed in Appendix A. Adjustments may be made to reflect local climates which differ from the tabulated temperatures, or local weather experience determined by the building official.

[2] The Degree Days Heating (base 65°F.) and cooling (base 65°F.) shall be selected from "NOAA Annual Degree Days to Selected Bases Derived from the 1961-1990 Normals," ASHRAE Handbook of Fundamentals, as listed in Appendix A, data available from adjacent military installations, Table J3.2.1, or other source of local weather data acceptable to the building official.

J3.2.2 Interior design conditions.

J3.2.2.1 Indoor design temperature: Indoor design temperature shall be 72°F for heating and 78°F for cooling.

J3.2.2.2 Design humidity: Indoor design relative humidity for heating shall not exceed 30%. For cooling, the actual design relative humidity within the comfort envelope as defined in ASHRAE Standard 55-92 listed in Appendix A shall be selected for minimum total HVAC system energy use in accordance with accepted practice.

J3.3 Living Space Ventilation Criteria.

J3.3.1 Ventilation: Living space fresh air ventilation shall conform to the requirements of 780 CMR 12 and the BOCA Mechanical Code, as listed in Appendix A.

Exception: If outdoor air quantities other than those specified in the BOCA Mechanical Code are used or required because of special occupancy or process requirements, source control of air contamination, health and safety, or other standards, the required outdoor air quantities shall be used as the basis for calculating the heating and cooling design loads.

780 CMR J4.0 GENERAL REQUIREMENTS

J4.1 Scope.

J4.1.1 General: All buildings that are mechanically heated or cooled and meet the provisions of Appendix J using the compliance paths of 780 CMR J5.0, J6.0, or J7.0 shall also meet the requirements of 780 CMR J4.0. Buildings that meet the provisions using the compliance paths of 780 CMR J8.0 or J9.0 are exempt from the requirements of 780 CMR J4.0.

Exception: All buildings must comply with the requirements of 780 CMR J4.2.1

J4.2 Building Envelope Requirements.

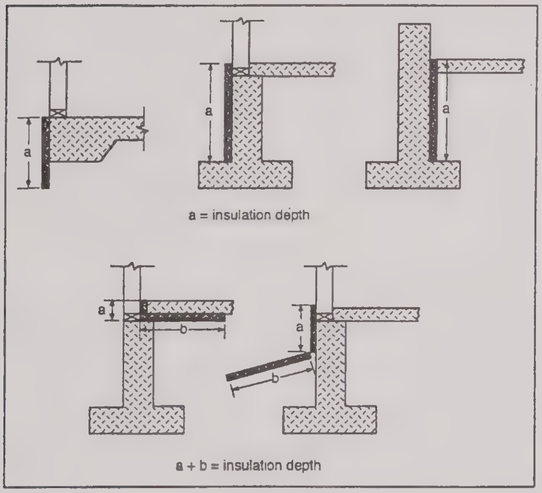
J4.2.1 Vapor Retarder: The design shall not create conditions of accelerated deterioration from moisture condensation. In all frame walls, floors, and ceilings not ventilated to allow moisture to escape, an approved vapor retarder having a maximum rating of 1.0 perm, when tested in accordance with Standard ASTM E 96, as listed in Appendix A, shall be installed on the warm-in-winter side of the thermal insulation.

Exception: In construction where moisture or its freezing will not damage the materials or adversely affect the performance of the insulation.

J4.2.2 Basements: The exterior walls of basements below uninsulated floors shall be insulated from the top of the foundation wall to a depth of ten feet (3048 mm) below the outside finish ground level, or to the level of the basement floor, whichever is less. Basement walls shall be insulated if the basement is a conditioned space.

J4.2.3 Slab-on-grade floors: Insulation shall be placed on the outside of the foundation or on the inside of a foundation wall. In climates with less than 6,000 annual Fahrenheit heating degree days (HDD_{65}), the insulation shall extend downward from the elevation of the top of the slab for a minimum distance of 24 inches (610 mm), or downward to at least the bottom of the slab and then horizontally to the interior or exterior for a minimum total distance of 24 inches (610 mm) and shall be an approved type. In climates equal to or greater than 6,000 annual Fahrenheit heating degree days (HDD_{65}), the insulation shall extend downward from the elevation of the top of the slab for a minimum of 48 inches (1219 mm), or downward to at least the bottom of the slab and then horizontally to the interior or exterior for a minimum total distance of 48 inches (1219 mm). In all climates, the horizontal insulation extending outside of the foundation shall be covered by pavement or by soil a minimum of ten inches (254 mm) thick. The top edge of the insulation installed between the exterior wall and the edge of the interior slab shall be permitted to be cut at a 45-degree angle away from the exterior wall. (see Figure J4.2.2.)

Figure J4.2.2
Typical Slab-on-grade Insulation Examples



J4.2.4 Crawl spaces: The floor above a crawl space shall be insulated to a minimum of R-19. See also 780 CMR 3603.6.8.2

J4.2.5 Access openings: Access doors, hatches, scuttles, pull down staircases and similar constructions that are part of the building envelope shall be insulated to a level equivalent to the insulation of the surrounding floor, wall, and ceiling.

> **Exception**: If the access opening has less insulation than the surrounding area, for calculation purposes the U-value of the surrounding floor, wall, and ceiling shall be increased accordingly.

J4.2.6 Masonry veneer: When insulation is placed on the exterior of a foundation supporting a masonry veneer exterior, the horizontal foundation surface supporting the veneer is not required to be insulated to satisfy the foundation insulation requirement.

J4.2.7 Return-Air Ceiling Plenums: When return-air ceiling plenums are employed, the roof/ceiling assembly shall:

1. For thermal transmittance purposes, not include the ceiling proper nor the plenum space as part of the assembly; and,
2. For gross area purposes, be based upon the interior face of the upper plenum surface.

780 CMR J4.3 Air leakage.

J4.3.1 The requirements of 780 CMR J4.3 shall apply to those locations separating outdoor ambient conditions or exempted portions of the building (e.g.- attics, unconditioned basements) from interior conditioned spaces.The requirements are not applicable to the separation of interior conditioned spaces from each other.

J4.3.2 Window and Door Assemblies: Exterior doors and windows shall be designed to limit air leakage into and from the building envelope. Manufactured doors and windows shall comply with the maximum allowable infiltration rates in Table J4.3.2.

> **Exception**: Site constructed windows and doors sealed in accordance with 780 CMR J4.3.3.

Table J4.3.2
Allowable Air Infiltration Rates[1]

Frame Type	Windows (cfm per ft of operable sash crack)	Doors (cfm per ft^2 of door area)	
Wood[2]	0.34	0.35[5]	0.5[6]
Alum[3]	0.37	0.37	0.5[6]
PVC[4]	0.37	0.37	0.5[6]

1. When tested in accordance with Standard ASTM E 283, as listed in Appendix A.
2. See Standard ANSI/NWWDA I.S.2, as listed in Appendix A.
3. See Standard ANSI/AAMA 101, as listed in Appendix A.
4. See Standards AAMA 101V and ASTM D 4099, each as listed in Appendix A.
5. Requirement based on door area specified in Standard ANSI/NWWDA I.S.3, as listed in Appendix A.
6. Requirement based on assembly area; except for manufactured (mobile) housing for which the requirement shall be 1.0 cfm/ft^2 (5.08 L/s/m^2) of door area; in accordance with Standard AAMA 1701.2 as listed in Appendix A.

J4.3.3 Joints, seams or penetrations in the building envelope that are sources of air leakage shall be sealed with durable caulking materials, closed with gasketing systems, taped or covered with moisture vapor permeable house-wrap per manufacturer's directions. Air leakage locations to be treated shall include openings, cracks and joints between framing members and window or door frames; between wall assemblies or their sill-plates and foundations; between walls and roof/ceilings or attic/ceiling seals and between separate wall panels; between walls and floor assemblies; penetrations of utility services through walls, floors and roof assemblies, penetration through the wall cavity of top and/or bottom plates; and all other such openings in the building envelope. Sealing materials shall be compatible with the construction materials, location, and anticipated conditions. Sealing materials spanning joints between dissimilar construction materials shall allow for differential expansion and contraction of the construction materials.

This includes sealing around tubs and showers, at the attic and crawl space access panels, at recessed lights and around all plumbing, electrical, and HVAC penetrations. These are openings located in the building envelope between conditioned space and unconditioned space or between the conditioned space and the outside.

J4.3.4 Recessed lighting fixtures: When installed in the building envelope, recessed lighting fixtures shall meet one of the following requirements:

1. Type IC rated, manufactured with no penetrations between the inside of the recessed fixture and ceiling cavity and sealed or gasketed to prevent air leakage into the unconditioned space.
2. Type IC rated, in accordance with Standard ASTM E 283, as listed in Appendix A, with no more than 2.0 cfm (0.944 L/s) air movement from the conditioned space to the ceiling cavity. The lighting fixture shall have been tested at 75 Pa or 1.57 lbs/ft.^{2} pressure difference and shall be labeled.

J4.4 Building Mechanical Systems

J4.4.1 General: 780 CMR J4.4 covers the determination of heating and cooling loads, design requirements, system and component performance control requirements, insulating systems and duct construction.

Note: 780 CMR J4.4 addresses, in depth, requirements for "simple" heating and cooling systems. "Simple" systems are characterized as those typically found in one-and two-family houses (such as standard design boilers, furnaces, air conditioners, or heat pumps that provide heating and/or cooling). 780 CMR J4.4 also covers requirements for more "complex" systems (such as those designed to deliver heating and cooling simultaneously, evaporative coolers, water chillers, and others,) but such "complex" systems are only cited in this section, with reference to the other sections of 780 CMR where detailed criteria are given.

J4.4.2 Calculation of heating and cooling loads:

J4.4.2.1 Calculation procedures: For the purpose of sizing HVAC systems, heating and cooling design loads shall be determined in accordance with techniques recommended in the ASHRAE Handbook of Fundamentals or the Air Conditioning Contractors Association's Manual "J", or other procedure approved by the Board of Building Regulations and Standards. The design parameters specified in 780 CMR J3.0 shall apply for all computations.

J4.4.2.1.1 System heating/cooling capacity: The rated output capacity of the heating/cooling system at design conditions shall not be greater than 125% of the design load calculated in accordance with this article. Equipment designed for standby purposes is not included in the capacity limitation requirement. For a single piece of equipment which has both heating and cooling capability, only one function, either the heating or the cooling, need meet the requirements of 780 CMR J4.4. Capacity for the other function shall be, within available equipment options, the smallest size necessary to meet the load.

Exception 1: If the rated output capacity of available equipment options exceeds 125% of the design load, then equipment with the smallest output capacity above 125% of the load shall be utilized.

Exception 2: Where the HVAC system for the building uses interconnected equipment designed to sequence with the load and it can be shown that such design will use less energy on an annual basis than one large unit.

J4.4.2.1.3 Simultaneous heating and cooling: See 780 CMR 1305.3.5.

J4.4.2.2 Infiltration: Infiltration for heating and cooling design loads shall be calculated for all buildings except one- and two-family dwellings by the procedures in Chapter 22 of the ASHRAE Handbook of Fundamentals. Calculations for one and two family dwellings may use the methods identified above or other accepted engineering practices.

J4.4.3 HVAC equipment performance requirements.

J4.4.3.1 Equipment and components:

J4.4.3.1.1 The requirements of 780 CMR J4.4.3.1 apply to equipment and mechanical component performance for heating, ventilating, and air-conditioning systems. Equipment efficiency levels are specified. Data furnished by the equipment supplier or certified under a nationally recognized certification program or rating procedure shall be used to satisfy these requirements.

J4.4.3.1.2 Where components from more than one manufacturer are assembled into systems regulated under 780 CMR J4.4.3, compliance shall be as specified in 780 CMR J4.4.3.2 through J4.4.3.6.

J4.4.3.1.3 Omission of minimum performance requirements for certain classes of HVAC equipment does not preclude use of such equipment where appropriate.

J4.4.3.2 HVAC system combustion equipment: Gas- and oil-fired comfort heating equipment shall have minimum efficiency levels not less than the values in Table J4.4.3.2a through J4.4.3.2c.

TABLE J4.4.3.2a
GAS- AND OIL-FIRED STEAM AND HOT WATER BOILERS- STANDARD RATING CONDITIONS AND MINIMUM PERFORMANCE

REFERENCE STANDARD	CATEGORY	RATING CONDITION	MINIMUM PERFORMANCE
Code of Federal Regulations, 10 CFR	Gas-Fired <300,000 Btu/h	Seasonal Rating	AFUE 80%[3,4]
Part 430, Subpart B, Appendix N	Oil-Fired <300,000 Btu/h	Seasonal Rating	AFUE 80%[3]
ANSI Z21.13, as listed in Appendix A	Gas-Fired ≥300,000 Btu/h	1. Maximum Rating Capacity[1] Steady-State	E_c[2] 80%
ANSI/ASME PTC 4.1, UL 795, each as listed in Appendix A		2. Minimum Rating Capacity[1] Steady-State	
UL 726, as listed in Appendix A	Oil-Fired ≥300,000 Btu/h	1. Maximum Rating Capacity[1] Steady-State	E_c[2] 83%
ANSI/ASME PTC 4.1, as listed in Appendix A		2. Minimum Rating Capacity[1] Steady-State	
Hydronics Institute, Testing & Ratings Standard for Heating Boilers, 1982 ANSI/ASME PTC 4.1, as listed in Appendix A	Oil-Fired (Residual)	1. Maximum Rating Capacity[1] Steady-State	E_c[2] 83%
	≥300,000 Btu/h	2. Minimum Rating Capacity[1] Steady-State	

For SI: 1 Btu/h = 0.2931 W.

1 Provided and allowed by the controls.

2 E_c = combustion efficiency, 100% minus flue losses. See reference standard for detailed information.

3 To be consistent with National Appliance Energy Conservation Act of 1987 (Public Law 100-12).

4 Except for gas-fired steam boilers for which minimum AFUE is 75%.

TABLE J4.4.3.2b
WARM AIR DUCT FURNACES AND UNIT HEATERS- STANDARD RATING CONDITIONS AND MINIMUM PERFORMANCE

REFERENCE STANDARD	CATEGORY	RATING CONDITION	MINIMUM PERFORMANCE
ANSI Z83.9, as listed in Appendix A	Duct Furnaces Gas-Fired	1. Maximum Rating Capacity[1] Steady-State	E_t[2] 78%
		2. Minimum Rating Capacity[1] Steady-State	E_t[2] 75%
ANSI Z83.8, as listed in Appendix A	Unit Heaters Gas-Fired	1. Maximum Rating Capacity[1] Steady-State	E_t[2] 78%
		2. Minimum Rating Capacity[1] Steady-State	E_t[2] 74%
UL 731, as listed in Appendix A	Unit Heaters Oil-Fired	1. Maximum Rating Capacity[1] Steady-State	E_t[2] 81%
		2. Minimum Rating Capacity[1] Steady-State	E_t[2] 81%

1 Provided and allowed by the controls.

2 E_t = thermal efficiency, 100% minus flue losses. See reference standard for detailed definition.

TABLE J4.4.3.2c
WARM AIR FURNACES AND COMBINATION WARM AIR FURNACES/AIR-CONDITIONING UNITS- STANDARD RATING CONDITIONS AND MINIMUM PERFORMANCE

REFERENCE STANDARD	CATEGORY	RATING CONDITION	MINIMUM PERFORMANCE
Code of Federal Regulations, 10 CFR	Gas-Fired <225,000 Btu/h	Seasonal Rating	AFUE 78%[3] E_t[2] 80%
Part 430, Subpart B, Appendix N	Oil-Fired <225,000 Btu/h	Seasonal Rating	AFUE 78%[3] E_t[2] 80%
ANSI Z21.47, as listed in Appendix A	Gas-Fired ≥225,000 Btu/h	1. Maximum Rating Capacity[1] Steady-State	E_t[5] 80%
		2. Minimum Rating Capacity[1] Steady-State	E_t[4] 78%
UL 727, as listed in Appendix A	Oil-Fired ≥225,000 Btu/h	1. Maximum Rating Capacity[1] Steady-State	E_t[4] 81%
		2. Minimum Rating Capacity[1] Steady-State	E_t[4] 81%

For SI: °F. = 1.8°C. + 32, 1 Btu/h = 0.2931 W.

1 Minimum and maximum ratings as provided for and allowed by the unit's controls.

2 These requirements apply to combination units not covered by NAECA (three phase power or cooling capacity > 65,000 Btu/h).

3 This is used to be consistent with National Appliance Energy Conservation Act (NAECA) of 1987 (Public Law 100-12). These values apply to furnace and combination units covered by NAECA.

4 See referenced standard for detailed definition of thermal efficiency (E_t) = (100% minus flue losses).

J4.4.3.3 HVAC system heating equipment, heat pump, heating mode. Heat pumps whose purchased energy input is entirely electric shall have efficiency levels for heating not less than the values in Table J4.4.3.3a through J4.4.3.3d. (NOTE: When more than one rating condition is listed by the manufacturer for a single piece of equipment, the rating type closer to the intended design conditions should be chosen.)

J4.4.3.3.1 780 CMR J4.4.3 applies to, but is not limited to, unitary (central) heat pumps (air source and water source) in the heating mode, to water-source (hydronic) heat pumps as used in multiple-unit hydronic HVAC systems, and to heat pumps in the packaged terminal air-conditioner and room air-conditioner forms in the heating mode.

TABLE J4.4.3.3a
HEAT PUMPS - AIR COOLED, ELECTRICALLY-OPERATED, <135,000 Btu/h COOLING CAPACITY STANDARD RATING CONDITIONS AND MINIMUM PERFORMANCE

REFERENCE STANDARD[1]	CATEGORY	SUB-CATEGORY & RATING CONDITIONS (Outdoor Temperature °F.)[2]	MINIMUM PERFORMANCE
ARI 210/240, as listed in Appendix A	<65,000 Btu/h	Seasonal Rating[1]	
	Cooling Capacity Heating Mode (Heat Pump)	Split systems Single Package	6.8 HSPF 6.6 HSPF
	≥65,000 Btu/h	Split Systems & Single Package	
	<135,000 Btu/h Cooling Capacity Heating Mode	High Temperature Rating (47°F db/43°F wb)	3.0 COP
		Low Temperature Rating (17°F db/15°F wb)	2.0 COP

For SI: °F = 1.8°C + 32, 1 Btu/h = 0.2931 W.

1 For multi-capacity equipment, the minimum performance shall apply to each capacity step provided. Multi- capacity refers to manufacturer published rating for more than one capacity mode allowed by the products' controls.

2 db = dry bulb; wb = wet bulb.

TABLE J4.4.3.3b
PACKAGED TERMINAL HEAT PUMPS - AIR COOLED, ELECTRICALLY OPERATED STANDARD RATING CONDITIONS AND MINIMUM PERFORMANCE

REFERENCE STANDARD	CATEGORY PTAC HEAT PUMPS	SUB-CATEGORY & RATING CONDITIONS (Outdoor Temperature °F)[1]	EFFICIENCY RATING	MINIMUM PERFORMANCE[2]
ARI 380, as listed in Appendix A	Heating Mode	Standard Rating (47°F db/43°F wb)	COP	2.9 - (0.026 x Cap/1,000)

For SI: °F = 1.8°C + 32, 1 Btu/h = 0.2931 W.

1 db = dry bulb; wb = wet bulb.

2 Capacity (Cap) means the rated cooling capacity of the product in Btu/h in accordance with Standard ANSI Z21.13, as listed in Appendix A. If the unit's capacity is less than 7,000 Btu/h, use 7,000 Btu/h in the calculation. If the unit's capacity is greater than 15,000 Btu/h, use 15,000 Btu/h in the calculation.

TABLE J4.4.3.3c
WATER-SOURCE AND GROUNDWATER SOURCE HEAT PUMPS - ELECTRICALLY-OPERATED <135,000 Btu/h COOLING CAPACITY STANDARD RATING CONDITIONS AND MINIMUM PERFORMANCE

REFERENCE STANDARDS	RATING CONDITION °F[1]	MINIMUM PERFORMANCE
Water Source Heat Pumps: ARI 320, as listed in Appendix A	Standard Rating 70°F entering water[2]	3.8 COP
Groundwater-Source Heat Pumps: ARI 325, as listed in Appendix A	1. High Temperature Rating 70°F entering water[3]	3.4 COP
	2. Low Temperature Rating 50°F entering water[3]	3.0 COP

For SI:°°F = 1.8°C + 32.

1 Air entering indoor section 70°F db/60°F wb (max.).

2 Water flow rate per manufacturer's specifications.

TABLE J4.4.3.3d
LARGE UNITARY HEAT PUMPS - AIR COOLED HEATING MODE-ELECTRICALLY-OPERATED >135,000 Btu/h COOLING CAPACITY STANDARD RATING CONDITIONS AND MINIMUM PERFORMANCE

REFERENCE STANDARDS	EFFICIENCY RATING	MINIMUM PERFORMANCE
ARI 340, as listed in Appendix A	COP (47°F)	2.9
Unitary Heat Pump Equipment	COP (17°F)	2.0

J4.4.3.3.2 Heat Pump Supplementary heater. The rated output capacity of a heat pump supplementary heating source shall not be greater than 125% of the design load as calculated in accordance with 780 CMR J4.4.2.1. The heat pump shall be installed with a control to prevent supplementary heater operation when the operating load can be met by the heat pump alone.

Supplementary heater operation is permitted during transient periods, such as start-ups, following room thermostat set-point advance and during defrost.

A two-stage thermostat, which controls the supplementary heat on its second stage, shall be accepted as meeting this requirement. The cut-on temperature for the compression heating shall be lower than the cut-on temperature for the supplementary heat, and the cut-off temperature for the compression heating shall be lower than the cut-off temperature for the supplementary heat. Supplementary heat may be derived from any source including, but not limited to, electric resistance, combustion heating or solar or stored-energy heating.

J4.4.3.4 HVAC system equipment, electrically operated, cooling mode. HVAC system equipment whose energy input in the cooling mode is entirely electric, shall have efficiency levels not less than the values in Tables J4.4.3.4a through J4.4.3.4f.

TABLE J4.4.3.4a
UNITARY AIR CONDITIONERS AND HEAT PUMPS - AIR COOLED, ELECTRICALLY OPERATED, <135,000 Btu/h COOLING CAPACITY - EXCEPT PACKAGED TERMINAL AND ROOM AIR CONDITIONERS STANDARD RATING CONDITIONS AND MINIMUM PERFORMANCE

REFERENCE STANDARD	CATEGORY	SUB-CATEGORY & RATING CONDITIONS (Outdoor Temperature °F)[1]	MINIMUM PERFORMANCE
ARI 210/240, as listed in Appendix A	<65,000 Btu/h Cooling Capacity Cooling Mode	Seasonal Rating[2]	
		Split systems	10.0 SEER
		Single Package	9.7 SEER
	≥65,000 Btu/h and <135,000 Btu/h Cooling Capacity Cooling Mode	Standard Rating (95°F db)	8.9 EER
		Integrated Part Load Value (80°F db)	8.3 IPLV

For SI: °F = 1.8°C + 32, 1 Btu/h = 0.2931 W.

1 db = dry bulb.

2 This is consistent with the National Appliance Energy Conservation Act of 1987 (Public Law 100-12).

TABLE J4.4.3.4b
UNITARY AIR CONDITIONERS AND HEAT PUMPS - EVAPORATIVELY COOLED, ELECTRICALLY OPERATED, AND COOLING MODE <135,000 Btu/h COOLING CAPACITY EXCEPT PACKAGED TERMINAL AND ROOM AIR CONDITIONERS STANDARD RATING CONDITIONS AND MINIMUM PERFORMANCE

		RATING CONDITIONS		
REFERENCE STANDARD	CATEGORY (Cooling Capacity)	INDOOR	OUTDOOR	MINIMUM PERFORMANCE
		(Temperature °F)[1]		
ARI 210/240, as listed in Appendix A	<65,000 Btu/h	Standard Rating 80°F db/67°F wb	95°F db/75°F wb	9.3 EER
	<65,000 Btu/h	Integrated Part Load Value (80°F db/67°F wb)		8.5 IPLV
CTI Standard 201, as listed in Appendix A	≥65,000 but <135,000 Btu/h	Standard Rating 80°F db/67°F wb	95°F. db/75°F wb	10.5 EER
	≥65,000 but <135,000 Btu/h	Integrated Part Load Value (80°F db/67°F wb)		9.7 IPLV

For SI: °F = 1.8°C + 32, 1 Btu/h = 0.2931 W.

1 db = dry bulb; wb = wet bulb.

TABLE J4.4.3.4c
WATER COOLED AIR CONDITIONERS AND HEAT PUMPS - ELECTRICALLY OPERATED, AND COOLING MODE <135,000 Btu/h COOLING CAPACITY STANDARD RATING CONDITIONS AND MINIMUM PERFORMANCE

		RATING CONDITIONS		
REFERENCE STANDARD	CATEGORY (Cooling Capacity)	INDOOR AIR	ENTERING WATER	MINIMUM PERFORMANCE
		(Temperature °F)[1]		
Water Source Heat Pump ARI 320, as listed in Appendix A CTI Standard 201, as listed in Appendix A	<65,000 Btu/h	Standard Rating 80°F db/67°F wb	85°F	9.3 EER
		Low Temperature Rating 80°F db/67°F wb	75°F	10.2 EER
	≥65,000 but <135,000 Btu/h	Standard Rating 80°F db/67°F wb	85°F	10.5 EER
Groundwater Cooled Heat Pumps ARI 325, as listed in Appendix A	<135,000 Btu/h	Standard Rating	70°F	11.0 EER
		Low Temperature Rating	50°F	11.5 EER
Water Cooled Unitary Air Conditioners ARI 210/240, as listed in Appendix A CTI Standard 201, as listed in Appendix A	≤65,000 Btu/h	Standard Rating 80°F db/67°F wb	85°F	9.3 EER
		Integrated Part Load Value	75°F	8.3 IPLV
	≥65,000 but <135,000 Btu/h	Standard Rating 80°F db/67°F wb	85°F	10.5 EER

For SI: °F = 1.8°C + 32, 1 Btu/h = 0.2931 W.

1 db = dry bulb; wb = wet bulb.

TABLE J4.4.3.4d
PACKAGED TERMINAL AIR CONDITIONERS - AIR COOLED, ELECTRICALLY OPERATED STANDARD RATING CONDITIONS AND MINIMUM PERFORMANCE

REFERENCE STANDARD	CATEGORY PTAC's & PTAC HEAT PUMPS	SUB-CATEGORY & RATING CONDITIONS (Outdoor Temperature)[1]	EFFICIENCY RATING	MINIMUM PERFORMANCE[2]
ARI Standard 310, as listed in Appendix A	Cooling Mode	Standard Rating (95°F db)	EER	10.0 - (0.16 x Cap/1,000)
		Low Temperature Rating (82°F db)	EER	12.2 - (0.20 x Cap/1,000)

For SI: °F = 1.8°C + 32, 1 Btu/h = 0.2931 W.

1 db = dry bulb.

2 Capacity (Cap) means the rated cooling capacity of the product in Btu/h in accordance with the cited ARI Standard. If the unit's capacity is less than 7,000 Btu/h, use 7,000 Btu/h in the calculation. If the unit's capacity is greater than 15,000 Btu/h, use 15,000 Btu/h in the calculation.

TABLE J4.4.3.4e
ROOM AIR CONDITIONERS AND ROOM AIR CONDITIONER HEAT PUMPS STANDARD RATING CONDITIONS AND MINIMUM PERFORMANCE

REFERENCE STANDARDS	CATEGORY	MINIMUM PERFORMANCE[1]
ANSI/AHAM RAC-1-, as listed in Appendix A	Without Reverse Cycle and With Louvered Sides	
	<6,000 Btu/h	8.0 EER
	≥6,000 Btu/h and <8,000 Btu/h	8.5 EER
	≥8,000 Btu/h and <14,000 Btu/h	9.0 EER
	≥14,000 Btu/h and <20,000 Btu/h	8.8 EER
	≥20,000 Btu/h	8.2 EER
	Without Reverse Cycle and Without Louvered Sides	
	<6,000 Btu/h	8.0 EER
	≥6,000 Btu/h and <20,000 Btu/h	8.5 EER
	≥20,000 Btu/h	8.2 EER
	With Reverse Cycle and With Louvered Sides	8.5 EER
	With Reverse Cycle and Without Louvered Sides	8.0 EER

For SI: 1 Btu/h = 0.2931 W.

1 To be consistent with National Appliance Energy Conservation Act of 1987 (Public Law 100-12).

TABLE J4.4.3.4f
LARGE UNITARY AIR CONDITIONERS AND HEAT PUMPS ELECTRICALLY-OPERATED >135,000 Btu/h COOLING CAPACITY STANDARD RATING CONDITIONS AND MINIMUM PERFORMANCE

REFERENCE STANDARDS	EFFICIENCY RATING	MINIMUM PERFORMANCE	
Air-Conditioners	EER	≤760,000 Btu/h: 8.5	>760,000 Btu/h: 8.2
Air Cooled ARI 360, as listed in Appendix A	IPLV	7.5	
Air-Conditioners	EER	9.6	
Water/Evap. Cooled	IPLV	0.9	
CTI Standard 201, ARI 360, each as listed in Appendix A			
Heat Pumps[1]		<760,000 Btu/h 8.5	≥760,000 Btu/h 8.2
Air Cooled-Cooling	EER		
ARI 340, as listed in Appendix A	IPLV	7.5	
Condensing Units[2]	EER	9.9	
Air Cooled ARI 365, as listed in Appendix A	IPLV	11.0	
Condensing Units[2]	EER	12.9	
Water/Evap. Cooled	IPLV	12.9	
CTI Standard 201, ARI 365, each as listed in Appendix A			

For SI: 1 Btu/h = 0.2931 W.

1 For units that have a heating section, deduct 0.2 from all required EER's and IPLV's.

2 Condensing unit requirements are based on single-number ratings defined in paragraph 5.1.3.2 of UL 731, as listed in Appendix A

J4.4.3.5 Mechanical Ventilation: Each mechanical ventilation system (supply and/ or exhaust) shall be equipped with a readily accessible switch or other means for shutoff or volume reduction and shutoff when venti-lation is not required. Automatic or gravity dampers that close when the system is not operating, or other acceptable method to prevent air leakage through ducts, shall be provided for outdoor air intake and exhausts.

J4.4.3.5.1 780 CMR J4.4.3.5 applies to, but is not limited to, unitary (central) cooling equipment (air cooled, water cooled and evaporatively cooled), the cooling mode of unitary (central) and packaged terminal heat pumps (air source and water source), and packaged terminal air conditioners and room air conditioners.

J4.4.3.6 Applied HVAC system components, electrically operated, cooling mode: See 780 CMR 1305.3.3c.

J4.4.4 Transport energy: See 780 CMR 1305.3.9.

J4.4.5 Balancing: The HVAC system design shall provide means for balancing air and water systems. In doing so, the considerations shall include, but not be limited to, dampers, temperature and pressure test connections and balance valves.

J4.4.6 Controls.

J4.4.6.1 Temperature control: Each system shall be provided with at least one adjustable thermostat for the regulation of temperature. Each thermostat shall be capable of being set by adjustment or selection of sensors as follows:

J4.4.6.1.1 When used to control heating only: 55 to 75°F (12.8 to 23.9°C).

J4.4.6.1.2 When used to control cooling only: 70 to 85°F (21.1 to 29.4°C).

J4.4.6.1.3 When used to control both heating and cooling, it shall be capable of being set from 55 to 85°F (12.8 to 29.4°C) and shall be capable of operating the system heating and cooling in sequence. The thermostat and/or control system shall have an adjustable deadband of 10°F (5.6°C) or more.

J4.4.6.2 Humidity control:See 780 CMR 1305.2.4.2, 1305.3.4.5, and 1305.3.4.6.

J4.4.6.3 Zoning for temperature control.

J4.4.6.3.1 One and two family dwellings: At least one thermostat for regulation of space temperature shall be provided for each separate HVAC system. In addition, a readily accessible manual or automatic means shall be provided to partially restrict or shut off the heating and/or cooling input to each zone or floor.

J4.4.6.3.2 Multifamily dwellings three stories or less in height: For multifamily dwellings, each individual dwelling unit shall have at least one thermostat for regulation of space temperature. A readily accessible manual or automatic means shall be provided to partially restrict or shut off the heating and/or cooling input to each room. For spaces other than living units at least one thermostat for regulation of space temperature shall be provided for:

1. Each separate system.
2. Each separate zone as defined in 780 CMR J2. As a minimum, each floor of a building shall be consid-ered as a separate zone. In a multi-story building where the perimeter system offsets only the transmission losses of the exterior wall, an entire side of uniform exposure may be zoned separately. A readily accessible manual or automatic means shall be provided to partially restrict or shut off the heating and/or cooling input to each floor.

J4.4.6.3.3 Control setback and shutoff: The thermostat required in 780 CMR J4.4.6.3.1 and J4.4.6.3.2 or an alternate means, including, but not limited to, a switch or a clock, shall provide a readily accessible manual or automatic means for reducing the energy required for heating and cooling during periods of non-use or reduced need including, but not limited to, unoccupied periods and sleeping hours. Lowering thermostat set points to reduce energy consumption of heating systems shall not cause energy to be expended to reach the reduced setting.

J4.4.7 Air-handling duct system insulation: Ducts, plenums, and enclosures installed in or on buildings shall be thermally insulated as follows:

J4.4.7.1 Duct systems, or portions thereof, shall be insulated to provide thermal resistance, as specified in Table J4.4.7.1.

Exceptions: Duct insulation, except as required to prevent condensation, is not required in the following cases:

1. When supply- or return-air ducts are installed in basements or cellars having insulated walls.
2. When the heat gain or loss of the ducts, without insulation, will not increase the energy requirements of the building.
3. Within HVAC equipment.
4. Exhaust air ducts.

TABLE J4.4.7.1
MINIMUM DUCT INSULATION[1]

	COOLING[2]		HEATING[3]	
Duct location	Annual Cooling Degree Days base 65°F CDD	Insulation *R*-Value[7] (h·ft^2·°F)/Btu	Annual Heating Degree Days base 65°F	Insulation *R*-Value[7] (h·ft^2·°F)/Btu
Exterior of building	below 500	3.3	4,501 to 7,500	6.5
	500 to 1,150	5.0	above 7,500	8.0
Inside of building envelope or in unconditioned spaces[4]				
TD^5≤15	—	Not Required	—	Not Required
40≥TD^5>15	—	3.3	—	3.3
TD^5>40	—	5.0^6	—	5.0^6

For SI: °F = 1.8°C + 32, 1 (h·ft^2·°F)/Btu = 0.176 m^2·k/W, 1 ft = 304.5 mm.

1. Insulation *R*-values shown are for the insulation as installed and do not include film resistance. The required minimum thicknesses do not consider water vapor transmission and condensation. Where control of condensation is required, additional insulation, vapor retarders, or both, shall be provided to limit vapor transmission and condensation. For ducts which are designed to convey both heated and cooled air, duct insulation shall be as required by the most restrictive condition. Where exterior walls are used as plenum walls, wall insulation shall be as required by the most restrictive condition of 780 CMR J4.4.7.
2. Cooling ducts are those designed to convey mechanically cooled air or return ducts in such systems.
3. Heating ducts are those designed to convey mechanically heated air or return ducts in such systems.
4. Unconditioned spaces include basements, crawl spaces, and attics.
5. TD is defined as the temperature difference at design conditions between the space within which the duct is located and the design air temperature in the duct.
6. Insulation resistance for runouts to terminal devices less than ten feet in length is not required to exceed an R-value of R-3.3. [(h·ft^2·°F)/Btu.]
7. Insulation resistance measured on a horizontal plane in accordance with ASTM C 518-85, Test Method for Steady State Heat Flux Measurements and Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus, at a mean temperature of 75°F at the installed thickness.

J4.4.8 Duct construction: As applicable, ductwork shall be constructed and erected in accordance with:

ACCA Manual D;
BOCA National Mechanical Code;
ASHRAE Handbook HVAC Systems and Equipment;
SMACNA, Installation Standards for Residential Heating and Air Conditioning Systems;
SMACNA, HVAC Duct Construction Standards - Metal and Flexible;
SMACNA Fibrous Glass Duct Construction Standards;
ASHRAE HVAC Applications Handbook;
NAIMA Fibrous Glass Duct Construction Standards, each as listed in Appendix A.

J4.4.8.1 High-pressure and medium-pressure ducts: See 780 CMR 1305.3.13.2.

J4.4.8.2 Duct sealing: The accessible joints, seams, and connections of all low-pressure supply and return ductwork that is located outside conditioned space, including stud bays or joist cavities/spaces used to transport air, shall be sealed using mastic with fibrous backing tape installed in accordance with the manufacturer's installation instructions. Other sealants may be approved by the Board of Building Regulations and Standards. For fibrous ducts, pressure sensitive tape may be used if installed in accordance with NAIMA Fibrous Glass Duct Construction Standards, as listed in Appendix A. Duct tape is not permitted as a sealant on any ducts.

Exception 1: Fibrous backing tape need not be used in the following cases:

1. On duct connections which are overlapped.
2. Where gaps are less than 1/8" in any dimension.
3. On flex duct connections with properly installed tension straps.

Exception 2: Lengthwise snap-lock joints on round or rectangular ducts need not be sealed if they are tight fitting.

J4.4.9 Piping insulation: Piping installed for space conditioning shall be thermally insulated in accordance with Table J4.4.9. For service water-heating systems, see 780 CMR J4.5.

Exceptions: Piping insulation is not required in the following cases:

1. Piping installed within HVAC equipment.
2. Piping at fluid temperatures between 55°F and 120°F (12.7°C and 48.9°C) when not required for energy conservation purposes.
3. When the heat loss and/or heat gain of the piping without insulation does not increase the energy requirement of the building.
4. When piping is installed in basements or cellars having insulated walls in one and two family dwellings.

TABLE J4.4.9
MINIMUM PIPE INSULATION[1] (Thickness in Inches)

PIPING SYSTEM TYPES	FLUID TEMPERATURE RANGE, °F	Pipe Sizes					
		Run Outs 2”[2]	1” and Less	1¼” to 2”	2½” to 4”	5” to 6”	8” and Larger
HEATING SYSTEMS Steam and hot water High pressure/temp	306-450	1½	2½	2½	3	3½	3½
Med. pressure/temp	251-305	1½	2	2½	2½	3	3
Low pressure/temp	201-250	1	1½	1½	2	2	2
Low temperature	120-200	½	1	1	1½	1½	1½
Steam condensate (for feed water)	Any	1	1	1½	2	2	2
COOLING SYSTEMS Chilled water,	40-55	½	½	¾	1	1	1
Refrigerant, or brine	below 40	1	1	1½	1½	1½	1½

For SI: 1 inch = 25.4 mm, °F = 1.8°C + 32, 1 ft = 304.8 mm.

1. For piping exposed to outdoor air, increase insulation thickness by ½ inch.
2. Runouts not exceeding 12 feet in length to individual terminal units.

J4.4.9.1 Other insulation thicknesses: Insulation thicknesses in Table J4.4.9 are based on insulation having thermal resistivity in the range of 4.0 to 4.6 h·ft^2·°F/Btu per inch (0.704 to 0.810 m^2·k/W per 25 mm) of thickness on a flat surface at a mean temperature of 75°F (24°C).

Minimum insulation thickness shall be increased for materials having values less than 4.0, or may be reduced for materials having values greater than 4.6 as follows.

For materials with thermal resistively greater than 4.6, the minimum insulation thickness may be reduced as follows:

$$\frac{4.6 \times \text{Table 503.9 Thickness}}{\text{Actual Resistivity}} = \text{New Minimum Thickness}$$

For materials with thermal resistively less than 4.0, the minimum insulation thickness shall be increased as follows:

$$\frac{4.0 \times \text{Table 503.9 Thickness}}{\text{Actual Resistivity}} = \text{New Minimum Thickness}$$

J4.5 Service Water Heating

J4.5.1 Scope: The purpose of 780 CMR J4.5 is to provide criteria for design and equipment selection that will produce energy savings when applied to service water heating. Water supplies to ice making machines, refrigerators, and toilets shall be taken from a cold-water line of the water distribution system.

J4.5.2 Water heaters, storage tanks and boilers.

J4.5.2.1 Performance efficiency: Water heaters and hot water storage tanks shall meet the minimum performance of water heating equipment specified in Table J4.5.2. Where multiple criteria are listed, all criteria shall be met.

Excption: Storage water heaters. Storage water heaters and hot water storage tanks having more than 140 gallons (530L) of storage capacity need not meet the standby loss (*SL*) or heat loss (*HL*) requirements of table J4.5.2 if the tank surface area is thermally insulated to *R*-12.5 and if a standing pilot light is not used.

J4.5.2.2 Insulation: Heat loss from unfired hot-water storage tanks shall be limited to a maximum of 6.5 Btu/h/ft.^{2} (20.5 W/m^2) of external tank surface area, based on 80°F (176°C) water-air temperature difference.

Exception: Unfired hot water storage tanks having more than 500 gallons (1893 L) of storage capacity thermally insulated to *R*-12.5.

J4.5.2.3 Combination service water heating/ space heating boilers: Service water-heating equipment shall not be dependent on year-round operation of space heating boilers; that is, boilers that have as another function winter space heating.

Exceptions:

1. Systems for which the input rating of the combined system is less than 150,000 Btu.
2. Systems for which the combined system capacity (input rating or storage volume) is less than twice that of the smaller of the separate heaters required in a system with separate space and water heating.
3. Systems with service/space heating boilers having a standby loss (Btu/h) (W) less than:

$$\frac{13.3\ pmd\ 400}{n}$$

determined by the fixture count method where:

pmd =probable maximum demand in gallons/hour as determined in accordance with Chapter 37 of the ASHRAE HVAC Systems and Applications Handbook, as listed in Appendix A.

n =fraction of year when outdoor daily mean temperature exceeds 64.9°F (18.3°C)

The standby loss is to be determined for a test period of 24 hour duration while maintaining a boiler water temperature of 90°F (32.2°C) above an ambient of 60 to 90°F (15.6 to 32.2°C) and a five-foot (1524 mm) stack on appliance.

TABLE J4.5.2
MINIMUM PERFORMANCE OF WATER HEATING EQUIPMENT

CATEGORY	TYPE	FUEL	INPUT RATING	V_T[1]	INPUT TO V_r RATIO (Btu/h/gal)	TEST METHOD	ENERGY FACTOR[3]	THERMAL EFFICIENCY E_T%	STANDBY LOSS %/hr[7]
NAECA Covered Water Heating Equipment[4]	all	electric	≤12 kW	all[6]		Code of Federal Regulations, 10 CFR Part 430 Subpart B, Appendix E	≥0.93-0.00132V		
	storage	gas	≤75,000 Btuh	all[6]			≥0.62-0.0019V		
	instantaneous	gas	≤200,000 Btuh[6]	all			≥0.62-0.0019V		
	storage	oil	≤105,000 Btuh	all			≥0.59-0.0019V		
	instantaneous	oil	≤210,000 Btuh	all			≥0.59-0.0019V		
pool heater		gal/oil	all	all		ANSI Z21.56, as listed in Appendix A		≥78%	
Other Water Heating Equipment[5]	storage	electric	all	all		ANSI Z21.10.3, as listed in Appendix A			≤0.30+27/V_r
			≥155,000 Btuh	all					
	storage/ instantaneous	gas/oil	>155,000 Btuh	all	<4,000			≥78%	≤1.3+114/V_r
				<10	<4,000			≥78%	≤1.3+95/V_r
				≥10	≥4,000			≥80%	—
					≥4,000			≥77%	≤2.3+67/V_r
Unfired Storage Tanks				all					≤6.5 Btuh/ square foot[8]

For SI: 1 Btuh/ft.^{2} = 3.155 W/m^2, 1 Btuh = 0.2931 W, 1 gallon = 3.785 L, °F. = 1.8°C + 32.

1. V_T is the storage volume in gallons as measured during the standby loss test. For the purpose of estimating the standby loss requirement using the rated volume shown on the rating plate, V_T should be no less than 0.95V for gas and oil water heaters and no less than 0.90V for electric water heaters.

3. V is rated storage volume in gallons as specified by the manufacturer.

4. Consistent with National Appliance Energy Conservation Act (NAECA) of 1987.

5. All except those water heaters covered by NAECA.

6. Code of Federal Regulations, 10 CFR Part 430 Subpart B, Appendix E, as listed in Appendix A, applies to electric and gas storage water heaters with rated volumes 20 gallons and gas instantaneous water heaters with input ratings of 50,000 to 200,000 Btuh.

7. When testing an electric storage water heater for standby loss using the test procedure of Section 2.9 of ANSI Z21.10.3-1990 Gas Water Heaters, Volume III, Circulating Tank, Instantaneous and Large Automatic Storage-Type Water Heaters, the electrical supply voltage shall be maintained within ±1% of the center of the voltage range specified on the voltage range specified on the water heater nameplate. Also, when needed for calculations, the thermal efficiency (Et) shall be 98%.

When testing an oil water heater using the test procedures of Section 2.8 and 2.9 of ANSI Z21.10.3, as listed in Appendix A, the following modifications will be made:

A vertical length of flue pipe shall be connected to the flue gas outlet of sufficient height to establish the minimum draft specified in the manufacturer's installation instructions. All measurements of oil consumption will be taken by instruments with an accuracy of ±1% or better.

The burner rate shall be adjusted to achieve an hourly Btu input rate within ±2% of the manufacturer's specified input rate with the CO_2 reading as specified by the manufacturer with smoke no greater than 1 and the fuel pump pressure within ±1% of the manufacturer's specification.

8. Heat loss of tank surface area (Btuh/ft.^{2}) based on 80°F. water-air temperature difference.

J4.5.3 Automatic controls: Service water-heating systems shall be equipped with automatic temperature controls capable of adjustment from the lowest to the highest acceptable temperature settings for the intended use. Temperature setting range shall be in accordance with Table 2 in Chapter 37 of ASHRAE HVAC Systems and Applications Handbook, as listed in Appendix A.

J4.5.4 Shutdown: A separate switch shall be provided to permit turning off the energy supplied to electric service water-heating systems. A separate valve shall be provided to permit turning off the energy supplied to the main burner(s) of all other types of service water-heating systems.

J4.5.5 Pump operation: Circulating hot-water systems shall be arranged so that the circulation pump(s) can be conveniently turned off, automatically or manually, when the hot-water system is not in operation.

J4.5.6 Pipe insulation: For re-circulating systems, piping heat loss shall be limited to a maximum of 17.5 Btu/h per linear foot (5.13 W per m^2) of pipe in accordance with Table J4.5.6, which is based on design external temperature no lower than 65°F (18.3°C). Other design temperatures must be calculated.

> **Exception**: Piping insulation is not required when the heat loss of the piping, without insulation, does not increase the annual energy requirements of the building.

TABLE J4.5.6
MINIMUM PIPE INSULATION
(Thickness in Inches)

SERVICE WATER HEATING	PIPE SIZES[1]			
	Noncirculating Runouts	Circulating Mains and Runouts		
TEMPERATURES °F	Up to 1"	Up to 1¼"	1½" to 2"	Over 2"
170-180	0.5	1.0	1.5	2.0
140-160	0.5	0.5	1.0	1.5
100-130	0.5	0.5	0.5	1.0

For SI: 1 inch = 25.4 mm, °F = 1.8°C + 32.

1. Nominal iron pipe size and insulation thickness. Conductivity K ≈ 0.27

J4.5.7 Swimming pools.

J4.5.7.1 All pool heaters shall be equipped with an ON-OFF switch mounted for easy access to allow shutting off the operation of the heater without adjusting the thermostat setting and to allow restarting without re-lighting the pilot light.

J4.5.7.2 Pool covers: Heated swimming pools shall be equipped with a pool cover.

Exception: Outdoor pools deriving over 20% of the energy for heating from renewable sources (computed over an operating season) are exempt from this requirement.

J4.5.7.3 Time clocks: Time clocks shall be installed so that the pump can be set to run in the off-peak electric demand period and can be set for the minimum time necessary to maintain the water in a clear and sanitary condition in keeping with applicable health standard.

J4.5.8 Conservation of hot water.

J4.5.8.1 Showers: Shower heads shall have a maximum flow rate of 2.5 gallons per minute (gpm) (0.158 L/s) at a pressure of 80 pounds per square inch (psi) (551 kPa) when tested in accordance with ASME A112.18.1, as listed in Appendix A.

J4.6 Electrical Power and Lighting.

J4.6.1 Electrical energy consumption: In multifamily dwellings, provisions shall be made to determine the electrical energy consumed by each tenant by separately metering individual dwelling units.

Exception: Motels, hotels, college dormitories and other transient facilities.

J4.6.2 Lighting power budget: The lighting system shall meet the applicable provisions of 780 CMR 1308.

Exception: One-and Two-Family dwellings and the dwelling portion of multifamily residential buildings.

780 CMR J5.0 RESIDENTIAL BUILDING DESIGN BY PRESCRIPTIVE PACKAGE

(Also see 780 CMR J1.1.3)
Compliance Approach #1

Notes:

1. The Prescriptive Package Approach is expectedly the most conservative for building envelope compliance. It does not require calculation of a building's thermal performance, but allows the user to simply select a set of components from a pre-determined group after establishing the weather site and glazing area of the building.
2. There is no interpolation or extrapolation allowed between packages in Table J5.2.1b.
3. The Prescriptive Package Approach (780 CMR J5.0) is intended for one and two-family detached buildings heated with fossil fuels and having glazing representing no more than 18% of the gross wall area. Also, such buildings must be either wood frame or mass wall construction (concrete, masonry, log): metal frame buildings are excluded.
4. For one and two-family buildings that do not meet the requirements in Note 3, and for all multi-family buildings, refer to 780 CMR J1.1.3. compliance alternatives 2. through 5.
5. Table J5.2.1b is based on a number of assumptions about the buildings it covers. These assumptions are stated fully in the Footnotes to that table, and should be reviewed to assure that the Table is suitable for use with any given proposed building.

J5.1 Scope.

J5.1.1 General: Buildings constructed to 780 CMR J5.0 that are heated and/or mechanically cooled shall meet the applicable requirements of 780 CMR J5.0 and 780 CMR J4.0.

J5.2 Exterior Envelope Requirements

J5.2.1 General: The various building assemblies (window, wall, ceiling, floor, etc.) shall conform to the thermal transmittance and resistance values in Table J5.2.1b.

TABLE J5.2.1a
HEATING DEGREE DAYS BASE 65 (HDD_{65})

City	HDD_{65}	City	HDD_{65}
Amherst	6404	Hyannis	6137
Barre Falls Dam	7699	Knightville Dam	7439
Bedford	6521	Lawrence	6322
Birch Hill Dam	7739	Lowell	6339
Blue Hill	6398	Middleton	6268
Boston	5641	Nantucket	5848
Brockton	6225	New Bedford	5426
Chatham	6058	Plymouth	6333
Chester	7279	Provincetown	6044
Clinton	6698	Reading	6573
Cummington Hill	7658	Rochester	6267
East Brimfield Lake	7027	South Weymouth	5936
East Wareham	6297	Springfield[1]	5754
Edgartown	5916	Stockbridge	7060
Falmouth	5713	Taunton	6346
Framingham	6262	Tully Lake	7552
Great Barrington	7445	West Medway	6650
Haverhill	6413	Worcester	6979
Hingham	6072		

Note 1: Table J5.2.1a is only utilized to support Table J5.2.1b.

Note 2: The heating degree day value for Springfield is only to be used for the cities and towns of Chicopee, Holyoke, West Springfield, Springfield, Agawam and Longmeadow. For all other surrounding towns of Springfield, design to the HDD value of Amherst.

Table J5.2.1b
Prescriptive Packages for One- and Two-Family Residential Buildings Heated with Fossil Fuels

	MAXIMUM		MINIMUM					
Package	Glazing Area[1] (%)	Glazing U-value[2]	Ceiling R-value[3]	Wall R-value[4]	Floor R-value[5]	Basement Wall R-value[6]	Slab Perimeter R-value[7]	Heating/Cooling Equipment Efficiency[8]
			Less than 5501 Heating Degree Days[9]					
A	up to 12%	0.50	38	13	19	10	6	minimum from J4 Tables
B	up to 12%	0.52	30	13	19	10	6	82 AFUE
C	12.1 to 15%	0.42	38	13	19	10	6	minimum from J4 Tables
D	12.1 to 15%	0.50	38	13	19	10	6	85 AFUE
E	15.1 to 18%	0.39	38	13	25	N/A	N/A	minimum from J4 Tables
F	15.1 to 18%	0.42	38	13	19	10	6	85 AFUE
			5501 to 5700 Heating Degree Days[9]					
G	up to 12%	0.46	38	13	19	10	6	minimum from J4 Tables
H	up to 12%	0.52	30	13	19	10	6	85 AFUE
I	12.1 to 15%	0.41	38	13	25	N/A	N/A	minimum from J4 Tables
J	12.1 to 15%	0.50	38	19	19	10	6	minimum from J4 Tables
K	12.1 to 15%	0.46	38	13	19	10	6	85 AFUE
L	15.1 to 18%	0.36	38	13	25	N/A	N/A	minimum from J4 Tables
M	15.1 to 18%	0.43	38	19	19	10	6	minimum from J4 Tables
N	15.1 to 18%	0.42	38	13	25	N/A	N/A	85 AFUE
O	15.1 to 18%	0.46	38	13	19	10	6	90 AFUE
P	15.1 to 18%	0.50	30	19	19	10	6	87 AFUE
			5701 to 6500 Heating Degree Days[9]					
Q	up to 12%	0.40	38	13	19	10	6	minimum from J4 Tables
R	up to 12%	0.52	30	19	19	10	6	minimum from J4 Tables

	MAXIMUM		MINIMUM					
Package	Glazing Area[1] (%)	Glazing U-value[2]	Ceiling R-value[3]	Wall R-value[4]	Floor R-value[5]	Basement Wall R-value[6]	Slab Perimeter R-value[7]	Heating/Cooling Equipment Efficiency[8]
S	up to 12%	0.50	38	13	19	10	6	85 AFUE
T	12.1 to 15%	0.36	38	13	25	N/A	N/A	minimum from J4 Tables
U	12.1 to 15%	0.46	38	19	19	10	6	minimum from J4 Tables
V	12.1 to 15%	0.44	38	13	25	N/A	N/A	85 AFUE
W	12.1 to 15%	0.52	30	19	19	10	6	85 AFUE
X	15.1 to 18%	0.32	38	13	25	N/A	N/A	minimum from J4 Tables
Y	15.1 to 18%	0.42	38	19	25	N/A	N/A	minimum from J4 Tables
Z	15.1 to 18%	0.42	38	13	19	10	6	90 AFUE
AA	15.1 to 18%	0.50	30	19	19	10	6	90 AFUE
	Greater Than 6500 Heating Degree Days[9]							
BB	up to 12%	0.31	38	13	25	N/A	N/A	minimum from J4 Tables
CC	up to 12%	0.43	38	19	19	10	6	minimum from J4 Tables
DD	up to 12%	0.45	38	13	19	10	6	90 AFUE
EE	up to 12%	0.50	30	19	19	10	6	85 AFUE
FF	12.1 to 15%	0.40	38	13	25	N/A	N/A	90 AFUE
GG	12.1 to 15%	0.50	38	19	19	10	6	90 AFUE
HH	12.1 to 15%	0.43	38	19	19	10	6	85 AFUE
II	15.1 to 18%	0.35	38	13	25	N/A	N/A	90 AFUE
JJ	15.1 to 18%	0.35	30	19	19	10	6	90 AFUE
KK	15.1 to 18%	0.42	38	19	19	10	6	90 AFUE

N/A - This package may not be used for buildings with insulated Basement Walls or Slabs.

Footnotes to Table J5.2.1b:

1. Glazing area is the ratio of the rough opening area of the glazing assemblies (including sliding-glass doors, skylights, and basement windows if located in walls that enclose conditioned space, but excluding opaque doors) to the exterior wall gross area, expressed as a percentage. Up to 1% of the total glazing area may be excluded from the U-value requirement. For example, 3 ft^2 of decorative glass may be excluded from the U-value requirement of a building design with 300 ft^2 of glazing area.
2. After January 1, 1999, glazing U-values must be tested and documented by the manufacturer in accordance with the National Fenestration Rating Council (NFRC) test procedure, or taken from Table J1.5.3a. U-values are for whole units: center-of-glass U-values cannot be used.
3. The ceiling R-values do not assume raised or oversized framing construction. If the insulation achieves the full insulation thickness over the exterior walls without compression, or if non-compressible insulation is used to achieve full R-value, R-30 insulation may be substituted for R-38 insulation. Ceiling R-values represent the sum of cavity insulation plus insulating sheathing (if used). For ventilated ceilings, insulating sheathing must be placed between the conditioned space and the ventilated portion of the roof.
4. Wall R-values represent the sum of the wall cavity insulation plus insulating sheathing (if used). Do not include exterior siding, structural sheathing, and interior drywall. For example, an R-19 requirement could be met EITHER by R-19 cavity insulation OR R-13 cavity insulation plus R-6 insulating sheathing. Wall requirements apply to wood-frame or mass (concrete, masonry, log) wall constructions, but do not apply to metal-frame construction.
5. The floor requirements apply to floors over unconditioned spaces (such as unconditioned crawlspaces, basements, or garages). Floors over outside air must meet the ceiling requirements.
6. The entire opaque portion of any individual basement wall with an average depth less than 50% below grade must meet the same R-value requirement as above-grade walls. Windows and sliding glass doors of conditioned basements must be included with the other glazing. Basement doors must meet the door U-value requirement described in Note b.
7. The R-value requirements are for unheated slabs. Add an additional R-2 for heated slabs.
8. If the building utilizes electric resistance heating use the compliance approaches found in 780 CMR J6, 7, 8, or 9. If you plan to install more than one piece of heating equipment or more than one piece of cooling equipment, the equipment with the lowest efficiency must meet or exceed the efficiency required by the selected package.
9. For Heating Degree Day requirements of the closest city or town see Table J5.2.1a

NOTES:

a) Glazing areas and U-values are maximum acceptable levels. Insulation R-values are minimum acceptable levels. R-value requirements are for insulation only and do not include structural components.

b) Opaque doors in the building envelope must have a U-value no greater than 0.35. Door U-values must be tested and documented by the manufacturer in accordance with the NFRC test procedure or taken from the door U-value in Table J1.5.3b. If a door contains glass and an aggregate U-value rating for that door is not available, include the glass area of the door with your windows and use the opaque door U-value to determine compliance of the door. One door may be excluded from this requirement (i.e., may have a U-value greater than 0.35).

c) If a ceiling, wall, floor, basement wall, slab-edge, or crawl space wall component includes two or more areas with different insulation levels, the component complies if the average R-value is greater than or equal to the R-value requirement for that component. Average R-value must be calculated by applying area-weighted U-values to the components, and determining the reciprocals. Glazing or door components comply if the area-weighted average U-value of all windows or doors is less than or equal to the U-value requirement (0.35 for doors).

780 CMR J6.0 RESIDENTIAL BUILDING DESIGN BY COMPONENT PERFORMANCE

(Manual Trade-off or
"Paper and Pencil" Approach)
(Also see 780 CMR J1.1.3)
Compiiance Approach #2

Notes:

1. The Component Performance Approach shown in 780 CMR J6.0 is a design-specific alternative to the Prescriptive Package Approach of 780 CMR J5.0.
2. The Component Performance Approach allows for trade-offs between all building envelope components, and heating and cooling equipment efficiencies. This approach allows greater flexibility than that allowed in the Prescriptive Packages listed in Table J5.2.1b.
3. The Component Performance Approach may be used only for wood or metal framed buildings, 16" or 24" on center. For other framing materials or configurations, use 780 CMR J7.0, J8.0, or J9.0.

J6.1 Scope

J6.1.1 General: Buildings constructed to 780 CMR J6.0 that are heated and/or mechanically cooled shall meet all applicable requirements of 780 CMR J6.0 and 780 CMR J4.0.

J6.2 Exterior Envelope Requirements

J6.2.1 General: To determine thermal transmittance compliance with the various wall, roof and floor assemblies, the Trade-Off Worksheet must be completed using the figures and tables provided.

J6.2.2 Instructions for Using the Trade-off Approach:

STEP 1: Find your climate zone based on the county in which your building is to be located shown in Figure J6.2.2.

STEP 2: Complete the general information at the top of the Trade-off Worksheet.

STEP 3: Complete the PROPOSED section of the Trade-off Worksheet. Provide the area, R-value and U-value of each component. Use net areas for walls and roof assemblies that contain windows, doors, or skylights. U-values can be found in Tables J6.2.2a through J6.2.2g. R-values in tables are based on cavity insulation plus insulating sheathing (if used).

If more than one type of insulation or glass is used for a building component (i.e. two different R-values in the ceiling) use the additional blank lines for each R or U value provided in each block of the proposed section.

(**Note**: Remember that, for heated basements, foundation walls that are 50% and greater above grade are considered "Walls" while foundation walls less that 50% above grade are considered "Basement Walls."

STEP 4: Compute the total Proposed UA. Multiply all proposed U-values by their corresponding area. Enter the results in the UA column. Sum the proposed UAs for all components and enter this sum in the *Total Proposed UA* box. Also sum the areas for Ceilings and Walls, and enter in the "Total Area" boxes. Transfer these "Total Areas" to the respective Required "Area" boxes.

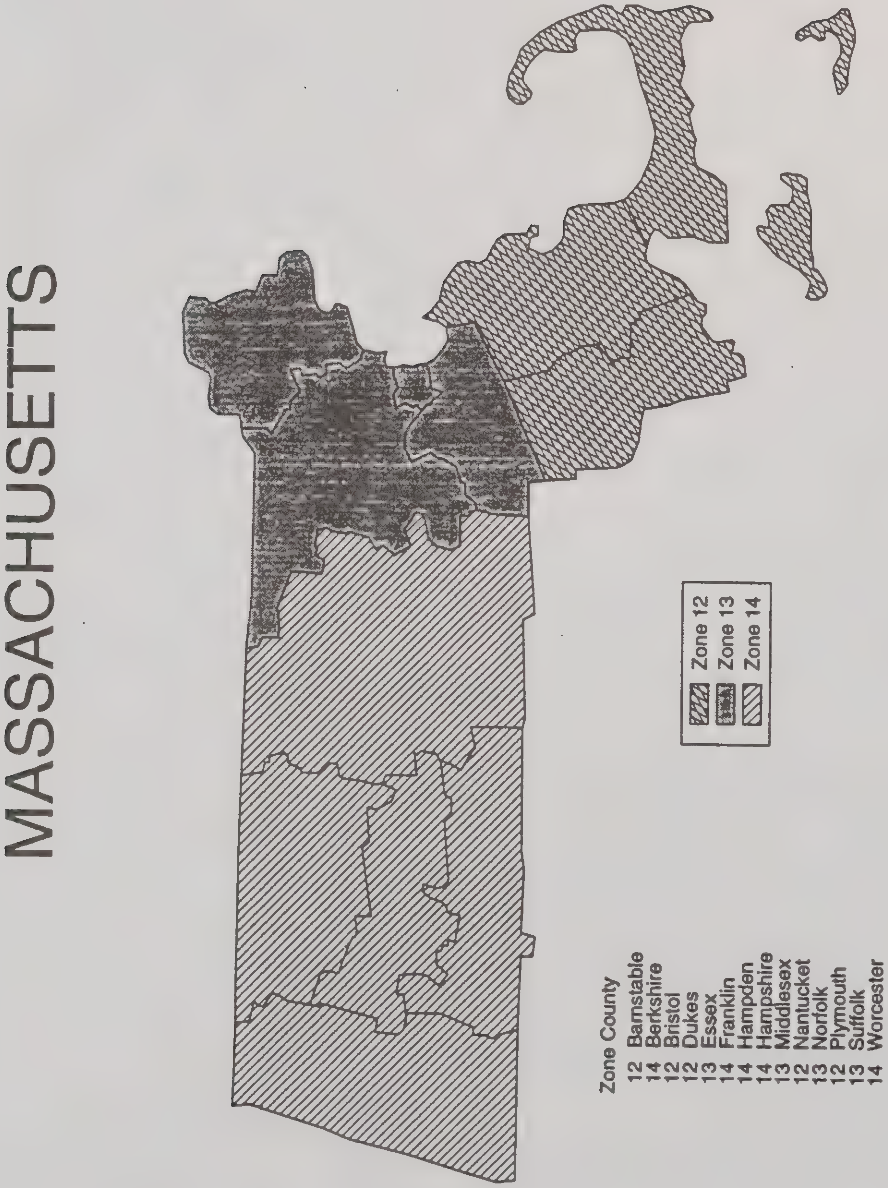
STEP 5: Complete the REQUIRED section of the Trade-Off Worksheet. Table J6.2.2h lists building component U-value requirements for each climate zone in Massachusetts. Enter the required U-values in the appropriate *Required U-value* column. Copy the total areas to the *Area* column of the *Required* side.

STEP 6: Multiply U-values in the Required column by their corresponding area; enter results in the UA column. Sum the UAs on the right side of the worksheet.

STEP 7: If high efficient HVAC is to be taken into account, complete the HVAC Trade-off Worksheet. Replace *Total Required UA* with HVAC adjusted UA (the new required UA will increase) from HVAC Trade-off worksheet.

STEP 8: Check for compliance. If the *Total Proposed UA* is less than or equal to the *Total Required UA* then your building complies with the thermal envelope requirements of Appendix J. If not, you must adjust insulation R-values, areas, and/or HVAC system efficiency in your proposed building.

FIGURE J6.2.2
State Map with Climate Zones



Zone	County
12	Bamstable
14	Berkshire
12	Bristol
12	Dukes
13	Essex
14	Franklin
14	Hampden
14	Hampshire
13	Middlesex
12	Nantucket
13	Norfolk
12	Plymouth
13	Suffolk
14	Worcester

TABLE J6.2.2a
Ceiling U-values

Insulation R-Value(a)	Standard Framing *U-Value*	*Raised Framing* U-Value(b)	Insulation *R-Value*(a)	Standard Framing *U-Value*	*Raised Framing* U-Value(b)
R-0	0.568	0.568	R-33	0.033	0.029
R-7	0.119	0.119	R-34	0.032	0.028
R-8	0.108	0.108	R-35	0.032	0.028
R-9	0.098	0.098	R-36	0.031	0.027
R-10	0.089	0.089	R-37	0.031	0.026
R-11	0.082	0.082	R-38	0.030	0.025
R-12	0.076	0.076	R-39	0.030	0.025
R-13	0.070	0.070	R-40	0.029	0.024
R-14	0.066	0.066	R-41	0.029	0.024
R-15	0.062	0.061	R-42	0.028	0.023
R-16	0.059	0.058	R-43	0.028	0.023
R-17	0.056	0.055	R-44	0.027	0.022
R-18	0.053	0.052	R-45	0.027	0.022
R-19	0.051	0.049	R-46	0.027	0.021
R-20	0.048	0.047	R-47	0.026	0.021
R-21	0.047	0.045	R-48	0.026	0.020
R-22	0.045	0.043	R-49	0.026	0.020
R-23	0.043	0.041	R-50	0.026	0.020
R-24	0.042	0.040	R-51	0.025	0.019
R-25	0.040	0.038	R-52	0.025	0.019
R-26	0.039	0.037	R-53	0.025	0.019
R-27	0.038	0.035	R-54	0.025	0.018
R-28	0.037	0.034	R-55	0.024	0.018
R-29	0.036	0.033	R-56	0.024	0.018
R-30	0.035	0.032	R-57	0.024	0.018
R-31	0.034	0.031	R-58	0.024	0.017
R-32	0.034	0.030	R-59	0.024	0.017

(a) R-values represent the sum of the ceiling cavity insulation plus the R-value of insulating sheathing (if used.) For example, R-19 cavity insulation plus R-5 sheathing is reported as R-24 ceiling insulation. For ventilated ceilings, insulating sheathing must be placed between the conditioned space and the ventilated portion of the roof (typically applied to the trusses or rafters immediately behind the drywall or other ceiling finish material.)

(b) To receive credit for raised framing, the insulation must achieve its full thickness over the exterior walls, or non-compressible insulation must be used to achieve full R-value.

TABLE J6.2.2b
Wood Frame Wall U-values

Insulation R-Value(c)	16-in. O.C. *Wall U-Value*	*24-in. O.C.* Wall U-Value
R-0	0.238	0.241
R-7	0.105	0.104
R-8	0.099	0.097
R-9	0.094	0.092
R-10	0.090	0.088
R-11	0.089	0.087
R-12	0.085	0.083
R-13	0.082	0.080
R-14	0.079	0.077
R-15	0.077	0.074
R-16	0.066	0.064
R-17	0.064	0.062
R-18	0.062	0.060
R-19	0.060	0.059
R-20	0.059	0.057
R-21	0.057	0.056

Insulation R-Value©	16-in. O.C. *Wall U-Value*	*24-in. O.C.* Wall U-Value
R-22	0.056	0.054
R-23	0.055	0.053
R-24	0.054	0.052
R-25	0.053	0.051
R-26	0.052	0.050
R-27	0.051	0.049
R-28	0.050	0.048

(a) U-values are for **uncompressed** insulation.

(b) Wall R-values are the sum of the cavity insulation plus insulating sheathing (if used.)

TABLE J6.2.2c
16 inches O.C. Metal Frame Wall U-values

Cavity *R-Value*	Insulating Sheathing R-Value									
	R-0	*R-2*	R-3	*R-4*	R-5	*R-6*	R-7	*R-8*	R-9	*R-10*
R-0	0.270	0.205	0.170	0.146	0.127	0.113	0.101	0.092	0.084	0.078
R-11	0.120	0.106	0.096	0.087	0.080	0.074	0.069	0.065	0.061	0.057
R-13	0.114	0.100	0.091	0.084	0.077	0.072	0.067	0.063	0.059	0.056
R-15	0.109	0.096	0.088	0.081	0.075	0.070	0.065	0.061	0.058	0.054
R-19	0.101	0.090	0.083	0.077	0.071	0.066	0.062	0.059	0.055	0.052
R-21	0.098	0.088	0.081	0.075	0.070	0.065	0.061	0.058	0.054	0.052
R-25	0.094	0.085	0.078	0.073	0.068	0.063	0.060	0.056	0.053	0.051

TABLE J6.2.2d
24 inches O.C. Metal Frame Wall U-values

Cavity *R-Value*	Insulating Sheathing R-Value									
	R-0	*R-2*	R-3	*R-4*	R-5	*R-6*	R-7	*R-8*	R-9	*R-10*
R-0	0.270	0.205	0.170	0.146	0.127	0.113	0.101	0.092	0.084	0.078
R-11	0.106	0.104	0.086	0.080	0.074	0.069	0.064	0.060	0.057	0.054
R-13	0.100	0.98	0.082	0.076	0.071	0.066	0.062	0.058	0.055	0.052
R-15	0.094	0.093	0.078	0.073	0.068	0.063	0.060	0.056	0.053	0.051
R-19	0.088	0.086	0.074	0.069	0.064	0.060	0.057	0.054	0.051	0.049
R-21	0.085	0.084	0.072	0.067	0.063	0.059	0.056	0.053	0.050	0.048
R-25	0.081	0.080	0.069	0.064	0.060	0.057	0.054	0.051	0.049	0.046

TABLE J6.2.2e
Floor U-values

Insulation R-Value	Floor U-Value
R-0	0.249
R-7	0.096
R-11	0.072
R-13	0.064
R-15	0.057
R-19	0.047
R-21	0.044
R-26	0.037
R-30	0.033

TABLE J6.2.2f
Basement U-values

Insulation R-Value	Basement Wall *U-Value*	*Insulation* R-Value	Basement Wall *U-Value*
R-0	0.360	R-10	0.072
R-1	0.244	R-11	0.067
R-2	0.188	R-12	0.062
R-3	0.155	R-13	0.059
R-4	0.132	R-14	0.055
R-5	0.115	R-15	0.052
R-6	0.102	R-16	0.050
R-7	0.092	R-17	0.047
R-8	0.084	R-18	0.045
R-9	0.077	R-19	0.043
		R-20	0.041

(a) Insulation R-values represent the sum of exterior and/or interior insulation. Basement walls must be insulated from the top of the basement wall to ten ft. below ground level, or to the floor of the basement, whichever is less.

TABLE J6.2.2g
Slab F-values

	Slab U-Value	
Perimeter Insulation *R-Value*	*24-in.* Insulation Depth	48-in. *Insulation Depth*
R-0	1.04	1.04
R-1	0.91	0.89
R-2	0.86	0.83
R-3	0.83	0.79
R-4	0.82	0.76
R-5	0.80	0.74
R-6	0.79	0.73
R-7	0.79	0.71
R-8	0.78	0.70
R-9	0.77	0.69
R-10	0.77	0.68
R-11		0.68
R-12		0.67
R-13		0.66
R-14		0.66
R-15		0.65
R-16		0.65
R-17		0.65
R-18		0.64
R-19		0.64
R-20		0.64

TABLE J6.2.2h
U-value Requirements by Climate Zone

Climate Zone	Ceiling U-value	Single Family Wall *U-value*[1]	Multi-Family Wall *U-value*	*Floor U-value*	Basement Wall *U-value*	Unheated Slab *F-value*	Heated Slab *F-value*
12	0.026	0.13	0.22	0.05	0.079	0.80	0.79
13	0.026	0.12	0.20	0.05	0.078	0.74	0.71
14	0.026	0.11	0.18	0.05	0.077	0.73	0.70

Note 1: Buildings heated by electric resistance require a U=0.105 for a Single Family Wall U-value in all zones.

Manual Trade-Off Worksheet

Permit #
Checked By
Date

Builder Name ______________________ Date ______________
Builder Address ______________________________________
Site Address ______________________ Zone ☐12 ☐13 ☐14
Submitted By ______________________ Phone ______________

PROPOSED — REQUIRED

Ceilings, Skylights, and Floors Over Outside Air

Description	Insulation R-Value	U-Value	x Net Area	=	UA
Ceiling (Table J6.2.2a)			ft^2	→	
Floor Over Outside Air (Table J6.2.2a)			ft^2	→	
			ft^2		
			ft^2		
		Total Area	ft^2	→	

Required U-Value (Table J6.2.2h)	x Area	= UA

Walls, Windows, and Doors

Description	Insulation R-Value	U-Value	x Net Area	=	UA
Walls (Table J6.2.2b,c,d)			ft^2	→	
Windows (NFRC or Table J1.5.3a)	-----		ft^2	→	
Doors (NFRC or Table J1.5.3b)	-----		ft^2	→	
Sliding Glass Doors (NFRC or Table J1.5.3a)	-----		ft^2	→	
			ft^2		
			ft^2		
		Total Area	ft^2	→	

Required U-Value	x Area	= UA

Floors and Foundations

Description	Insulation Depth	Insulation R-Value	U-Value	x Area or Perimeter	= UA	Required U-Value	x Area	= UA
Floor Over Unconditioned Space	(Table J6.2.2e)			ft^2				
Basement Wall	(Table J6.2.2f)			ft^2				
Unheated Slab (Table J6.2.2g)	in.			ft				
Heated Slab (Table J6.2.2g)	in.			ft				
				ft^2				
				ft^2				

Total Proposed UA* must be less than or equal to *Total (or Adjusted) Required UA

Total Proposed UA ☐

Total Required UA ☐

OR

Adjusted Required UA ☐

Statement of Compliance: The proposed building design represented in *these documents is consistent with the building plans, specifications,* and other calculations submitted with the permit application.

______________________ ______________________ ______________
Builder/Designer *Company Name* *Date*

HVAC Trade-Off Worksheet

1. Calculate efficiency Increase in percent:

$$\frac{EFF_{installed} - EFF_{standard}}{EFF_{standard}} = \% \text{ increase} \longrightarrow$$

2. Adjust the % increase according to Trade-off Ratio (Table 1 below):

(% increase X Trade-off Ratio) + 1 = **Adjusted Ratio** →

3. Adjust *Total Required UA* (from Manual Trade -Off Worksheet):

Total Required UA X **Adjusted Ratio = Adjusted Required UA** →

4. Use Adjusted Required UA as new *Total Required UA*, and check if *Total Proposed UA* is now less than or equal to it.

Total Proposed UA
(from Manual Trade-Off Worksheet)
↔
Total Required UA

Work Space:

Table 1
Trade-off Ratios

City/Town	HDD_{65}	Ratio, ß	City/Town	HDD_{65}	Ratio, ß
Amherst	6404	1.15	Hyannis	6137	1.13
Bedford	6521	1.15	Lawrence	6322	1.14
Blue Hill	6398	1.15	Middleton	6268	1.14
Boston	5641	1.11	Nantucket	5848	1.12
Brocton	6225	1.14	New Bedford	5426	1.10
Chatham	6058	1.13	Plymouth	6333	1.14
Clinton	6698	1.16	Provincetown	6044	1.13
East Wareham	6297	1.14	Rochester	6267	1.14
Edgartown	5916	1.13	Springfield	5754	1.12
Falmouth	5713	1.12	Stockbridge	7060	1.17
Framingham	6262	1.14	Taunton	6346	1.14
Haverhill	6413	1.15	Tully Lake	7552	1.19
			Worcester	6979	1.17

Table 2
NAECA Minimum Equipment Efficiencies[1]

Equipment Type	Minimum	Equipment Type	Minimum
Furnace	78 AFUE	Heat Pump: Heating Mode	6.8 HSPF
Boiler: Except Gas Steam	80 AFUE	Heat Pump: Cooling Mode	10 SEER
Boiler: Gas Steam	75 AFUE	Air Conditioner	10 SEER

1. Note: No Trade-off available for electric Resistance Heating.

780 CMR J7.0 RESIDENTIAL BUILDING DESIGN BY MAScheck SOFTWARE

(Also see 780 CMR J1.1.3)
Compliance Approach #3

Notes:

1. The MAS*check* Software produces similar results to the Component Performance Approach stated in 780 CMR J6.0. However, the software produces results in less time, performs trade-offs quickly, and creates a spread sheet of building components and an inspection report.
2. Installation and operating instructions are contained in the Users Guide, which comes with MAScheck Software.
3. Minimum computer requirements for operating MAScheck Software are:
   (a) a personal computer with the Intel 80386 (386) processor (or higher),
   (b) a 3½" diskette drive,
   (c) 530 kilobytes (KB) of conventional *RAM* memory,
   (d) a hard disk with 1 megabyte (MB) of free disk space,
   (e) *VGA* or Super *VGA* monitor,
   (f) MS-DOS Version 3.1 or later,
   (g) Microsoft-compatible mouse is highly recommended but not required.

J7.1 Scope

J7.1.1 General: Buildings constructed to 780 CMR J7.0 that are heated and/or mechanically cooled shall meet the applicable requirements of 780 CMR J7.0 and 780 CMR J4.0.

J7.2 Exterior Envelope Requirements

J7.2.1 General: To determine thermal transmittance compliance with the various wall, roof and floor assemblies, the MAS*check* Software analysis must be completed, and the "Your Home" UA value must be less than or equal to the "Required" UA value calculated by the software.

780 CMR J8.0 RESIDENTIAL BUILDING DESIGN BY SYSTEMS ANALYSIS

("Total Energy Analysis")
(Also see 780 CMR J1.1.3)
Compliance Approach #4

Notes:

1. The Systems Design Analysis outlined in 780 CMR J8.0 is the most refined means for Energy Code compliance.
2. If the proposed design takes credit for reduced air changes per hour (below 0.5 ACH), documentation of post-construction testing to verify air change rate shall be provided.
3. Calculation tools shall be approved by the BBRS.

J8.1 Scope

J8.1.1 General: 780 CMR J8 establishes design criteria in terms of total energy use by a residential building, including all of its systems.

J8.2 Systems Analysis

J8.2.1 Energy Analysis: Compliance with 780 CMR J8 will require an analysis of the annual energy usage, hereinafter called an annual energy analysis.

Exception: 780 CMR J4 and J6 establish criteria for different energy-consuming and enclosure elements of the building which, if followed, will eliminate the requirement for an annual energy analysis while meeting the intent of Appendix J.

A building designed in accordance with 780 CMR J8 will be deemed as complying with Appendix J if the calculated annual energy consumption is not greater than a similar building (defined as a "standard design") whose enclosure elements and energy-consuming systems are designed in accordance with 780 CMR J4 and J6.

For a proposed alternate building design to be considered similar to a "standard design," it shall utilize the same energy source(s) and equipment types for the same functions and have equal floor area and the same ratio of thermal envelope area to floor area, exterior design conditions, occupancy, climate data, and usage operational schedule.

Building designs and energy calculations shall be supported by documentation consistent with Massachusetts registration laws for engineers and architects, and otherwise consistent with the requirements of Appendix J.

J8.2.1.1 Input values for Group R buildings: The following input values shall be used in calculating annual energy performance. The requirements of 780 CMR J8 specifically indicate which variables shall remain constant between the standard building and the proposed building calculations. The standard building shall be a base-version of the design that directly complies with the provisions of Appendix J4 and J6. The proposed building may utilize a design that is demonstrated, through calculations satisfactory to the building official, to have equal or lower annual energy use than the standard design.

Glazing Systems

Orientation of the standard design	Equal area on north, south, east and west exposures.
Shading, standard design	Draperies shall be assumed to be closed during periods of mechanical air conditioning operation. Glazing areas in the standard design shall not be provided with extra exterior shading beyond shading that is provided by typical construction practices—such as roof overhangs. Energy performance impacts of added exterior shading for glazing areas may be accounted for in the proposed design for a specific building, provided that the actual installation of such systems is approved by the building official. Results from exterior shading calculations on one proposed building shall not be used for groups of buildings.

Heat Storage (Thermal Mass)

Internal mass	8 pounds per square foot (39 kg/m^2)
Structural mass	3.5 pounds per square foot (17 kg/m^2)

Passive solar building designs shall utilize at least 45 Btu/°F (26 kJ/°C) of additional thermal mass, per square foot (m^2) of added glass area, when added south-facing glass area exceeds 33% of the total glass area in walls.

Building Thermal Envelope—Surface Area and Volume

Floor, walls, ceiling	The standard and proposed designs shall have equal areas.
Foundation and floor type:	The foundation and floor type for both the standard and the proposed design shall be equal.
Glazings, including skylights	The area of glazing in the standard design shall not be greater than the area of glazing in the proposed design. The U_g-value of the standard design shall be selected to permit calculated U_o-wall compliance of the standard design.
Doors of TYPE I structures	The standard design shall have at least 40 square feet (3.7 m^2) of door area.
Building volume	The volumes of both the standard and proposed design shall be equal.

PARAMETER	**VALUE**
Thermostat (constants)	
Heating set point	68°F. (20°C.)
Cooling set point	78°F. (26°C.)
Night set back	60°F. (16°C.)
Set back duration	7 hours
Number of set-back periods	1(n)[a]
Maximum number of zones	2
Number of thermostats per zone	1
Internal Sensible Heat Gains (constants)	
TYPE I Units	1,500 Btu/hr (440 W)
TYPE II Units	3,000 Btu/hr (879 W)
Domestic Water Heater (calculate, then constants)	
Temperature set point	120°F (49°C)
Daily hot water consumption	Gallons = (30 x *n*[b] - units) + (10 x *n* - bedrooms)

a units = number of living units in proposed design (n).
b bedrooms = number of bedrooms in each living unit.

Site Weather Data (constants)
The typical meteorological year (TMY), or its "Ersatz" equivalent, from the National Oceanic and Atmospheric Administration (NOAA), Table J3.2.1, or an approved equivalent, for the closest available location shall be used.

Distribution System Loss Factors

	Duct Location	
Mode	**Outside**	**Inside**
Heating	0.75	1.00
Cooling	0.80	1.00

The Heating and Cooling Systems Efficiency shall be proportionally adjusted for those portions of the ductwork located outside or inside the conditioned space using the values shown above, in the following equation:

Total Adjusted System Efficiency = Equipment Efficiency x Distribution Loss Factor x percent of ducts outside + Equipment Efficiency x Distribution Loss Factor x percent of ducts inside.

Note: Ducts located in a space which contains a positive heat supply shall be considered as in an inside location.

Air Infiltration

Air changes per hour (ACH) for the standard design is 0.50 (for purposes of calculation only).

If the proposed design takes credit for ACH levels below 0.50, results of a post-construction blower-door test shall be provided to the building official using Standard ASTM E 779, as listed in Appendix A.

J8.2.2 Design: The standard design, conforming to the criteria of Residential Building Design by Component Performance Approach or Residential Building Design by Acceptable Practice and the proposed alternative design shall be designed on a common basis as specified herein:

1. The comparison shall be expressed as Btu input per square foot of gross floor area per year at building site.
2. If the proposed alternative design results in an increase in consumption of one energy source and a decrease in another energy source, even though similar sources are used for similar purposes, the difference in each energy source shall be converted to equivalent energy units for purposes of comparing the total energy used.
3. The different energy sources shall be compared on the basis of energy use at the site where: 1 kWh = 3,413 Btu.

J8.2.3 Analysis Procedure: The analysis of the annual energy usage of the standard and the proposed alternative building and system design shall meet the following criteria:

1. The building heating and cooling load calculation procedures used for annual energy consumption analysis shall be detailed to permit the evaluation of effect of factors specified in 780 CMR J8.2.4.
2. The calculation procedure used to simulate the operation of the building and its service systems through a full-year operating period shall be detailed to permit the evaluation of the effect of system design, climatic factors, operational characteristics, and mechanical equipment on annual energy usage. Manufacturer's data or comparable field test data shall be used when available in the simulation of systems and equipment. The calculation procedure shall be based upon 8,760 hours of operation of the building and its service systems and shall utilize the design methods specified in ASHRAE Handbook of Fundamentals, ASHRAE HVAC Systems and Applications Handbook, ASHRAE, Energy Calculations I, ASHRAE, Energy Calculations II, each as listed in Appendix A.

J8.2.4 Calculation Procedure: The calculation procedure shall cover the following items:

1. Design requirements -- Environmental requirements as required in 780 CMR J3.
2. Climatic data -- Coincident hourly data for temperatures, solar radiation, wind and humidity of typical days in the year representing seasonal variation.
3. Building data -- Orientation, size, shape, mass, air, moisture, and heat transfer characteristics.
4. Operational characteristics -- Temperature, humidity, ventilation, illumination, control mode for occupied and unoccupied hours.
5. Mechanical equipment -- Design capacity, part load profile.
6. Building loads -- Internal heat generation, lighting, equipment, number of people during occupied and unoccupied periods.

J8.2.4.1 Use of Approved Calculation Tool: The same calculation tool shall be used to estimate the annual energy usage for space heating and cooling of the standard design and the proposed design.

J8.2.5 Documentation: Proposed alternative designs, submitted as requests for exception to the standard design criteria, shall be accompanied by an energy analysis comparison report. The report shall provide technical detail on the two building and system designs and on the data used in and resulting from the comparative analysis to verify that both the analysis and the designs meet the criteria of 780 CMR J8 of Appendix J.

Exception: Proposed alternative designs for one and two family dwellings and multifamily buildings having a conditioned floor area of 5,000 square feet (464 m^2) or less are exempted from the full-year analysis described in 780 CMR J8.3 and J8.4. However, comparison of heating, cooling and service water heating equipment energy consumption between the alternative design and the standard design shall be provided.

780 CMR J9.0 RESIDENTIAL BUILDING DESIGN UTILIZING RENEWABLE ENERGY SOURCES

(Also see 780 CMR J1.1.3)
Compliance Approach #5

Notes:

1. The Renewable Energy approach outlined in 780 CMR J9.0 allows for portions of a proposed building's energy use to be discounted when performing energy compliance calculations.
2. 780 CMR J9.0 must be used in conjunction with 780 CMR J8.0.

J9.0 Renewable Energy Source Analysis

J9.1 General: A proposed building utilizing solar, geothermal, wind or other renewable energy sources for all or part of its energy source shall meet the requirements of 780 CMR J8.0, except such renewable energy may be excluded from the total annual energy consumption allowed for the building by 780 CMR J8.0.

J9.1.1 To qualify for this exclusion, such renewable energy must be derived from a specific collection, storage, and distribution system. The solar energy passing through windows shall also be considered as qualifying if such windows are provided with:

Operable insulation shutters or other devices which, when drawn or closed, shall cause the window area to reduce maximum outward heat flows to those in accordance with 780 CMR J4.3.2.

J9.1.2 Exclusion shall be granted for solar energy passing through windows provided:

1. The glass is double or triple pane insulating glass with a low emittance coating on one or more air space surfaces of the glass, or insulating glass with a low-emittance plastic film suspended in the air space, and
2. The glass areas are shaded from direct solar radiation during periods when mechanical cooling is requested.

J9.1.3 Other criteria covered in 780 CMR J8.0 shall apply to the proposed alternative designs utilizing renewable energy sources of energy.

J9.2 Documentation: Proposed alternative designs submitted as requests for exception to the standard design criteria shall be accompanied by an energy analysis, as specified in 780 CMR J8.0. The report shall provide technical detail on the alternative building and systems designs and on the data employed in and resulting from the comparative analysis as to verify that both the analysis and the designs meet criteria of 780 CMR J8.0.

The energy derived from renewable sources and the reduction in conventional energy requirements derived from nocturnal cooling shall be separately identified from the overall building energy use. Supporting documentation on the basis of performance estimates for the aforementioned renewable energy sources or nocturnal cooling means must be submitted.

Exception: Proposed alternative designs for residential buildings of less than 20,000 square feet (1858 m^2) that derive a minimum of 30% of their total annual energy usage from renewable energy sources or from nocturnal cooling shall be exempt from the requirement of a full-year energy system analysis, providing that the annual input of such renewable sources or the extent of such nocturnal cooling can be expected to meet the demands imposed by the proposed alternative design.

780 CMR J10.0 VALIDITY

If a section, subsection, sentence, clause or phrase of Appendix J is, for any reason, held to be unconstitutional, such section shall not affect the validity of the remaining portions of 780 CMR.

J11.0 Home Energy Rating

J11.1 General: A proposed building, for which the builder or the buyer obtains a Home Energy Rating by an accredited Home Energy Rating System (HERS), will be considered to comply with the intent of Appendix J if the rating score on the building is 83.0 or more points.

J11.1.1 Accreditation: Accreditation of the rating organization or agency with the Residential Energy Services Network (RESNET) or the Massachusetts Division of Energy Resources is required for acceptance of the energy rating as a compliance tool for *Appendix J*.

J11.1.2 Rating Score: The minimum compliance score of 83 points will be based on the national HERS Council's guidelines for Home Energy Ratings, and the rating score shall be determined with an acceptable software analysis program as required by RESNET accreditation procedures, on a scale of 0-100 points.

J11.2 Documentation: Compliance report which includes a proposed Energy Rating score of 83.0 or more points, a description of the building's energy features, and a statement that the rating score is "based on plans" will be required for issuance of a building permit. A copy of the final rating certificate indicating the score of 83.0 or more points for the finished building will be submitted to the building official before the Certificate of Occupancy is issued.

APPENDIX J REFERENCED STANDARDS

Standard Reference Number	Where Referenced in Appendix J (by Section Number)
ACCA Manual D	J4.4.8
ANSI/ASME PTC 4.1	Table J4.4.3.2a
ANSI/AHAM RAC-1	Table J4.4.3.4e
ANSI Z21.10.3	J4.5.2
ANSI Z21.47	Table J4.4.2.2c
ANSI Z21.56	J4.5.2
ANZI Z21.13	Tables J4.4.3.2a; J4.4.3.3b
ANZI Z83.8	Table J4.4.3.2b
ANZI Z83.9	Table J4.4.3.2b
ASHRAE HVAC Applications Handbook	J4.4.8
ASHRAE Handbook HVAC Systems and Equipment	J4.4.8
ASHRAE 55	J2.0
ASTM E 779	J8.2.1.1
ARI 210/240	Tables J4.4.3.3a; J4.4.3.4a-d
ARI 320	Tables J4.4.3.3c; J4.4.3.4c
ARI 325	Tables J4.4.3.3d; J4.4.3.4d
ARI 340	Tables J4.4.3.3d; J4.4.3.4f
ARI 360	Table J4.4.3.4f (also see 780 CMR 13, Table 1311.6)
ARI 365	Table J4.4.3.4f
ARI 380	J2.0; Table J4.4.3.3b
ARI 550	Table J4.4.3.4f (also see 780 CMR 13, Table 1311.6)
CTI Standard 201	Tables J4.4.3.4b,c and f (also see 780 CMR 13, Table 1311.6)
Code of Federal Regulations, 10 CFR Part 430, Subpart B, Test Procedures	J2.0; Tables J4.4.3.2a and c; Table J4.5.2
NAIMA Fibrous Glass Duct Construction Standards	J4.4.8
SMACNA Duct Construction Standards, Metal and Flexible	J4.4.8
SMACNA Fibrous Glass Duct Construction Standards	J4.4.8
UL 726	Table J4.4.3.2a
UL 727	Table J4.4.3.2c
UL 731	Tables J4.4.3.2b; J4.4.3.4f
UL 795	Table J4.4.3.2a

ACCA	Air Conditioning Contractors of America, Washington, DC
ANSI	American National Standards Institute, Inc.., New York, NY
ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc., Atlanta, GA
ASTM	American Society for Testing and Materials, Philadelphia, PA
ARI	Air Conditioning and Refrigeration Institute, Arlington, VA
CTI	Cooling Tower Institute, Houston, TX
NAIMA	North American Insulation Manufacturers Association, Alexandria, VA
SMACNA	Sheet Metal and Air Conditioning Contractors National Association, Inc., Chantilly, VA
UL	Underwriters Laboratories, Northbrook, IL

APPENDIX K

FLOOR PROTECTOR THERMAL CONDUCTIVITY CALCULATIONS

(Reference 780 CMR 3610.7.1 and 3610.6.7.1.1)

OVERVIEW

Floor protection requirements for heat producing appliances are typically included as part of the tested/listed installation criteria for such appliances.

Such floor protection, listed as a thermal conductivity factor is often developed utilizing NFPA SUBJECT 1618, "OUTLINE OF INVESTIGATION FOR WALL PROTECTORS, FLOOR PROTECTORS, AND HEARTH EXTENSIONS". (Note that an NFPA SUBJECT is not treated nor maintained in the same manner as an NFPA STANDARD).

When floor protection is developed utilizing NFPA SUBJECT 1618, or developed via "good Engineering Practice", such methodology will typically establish floor protection based on ⅜ inch millboard.

As the thermal conductivity of such millboard can vary from manufacturer to manufacturer, it will be necessary to obtain the thermal conductivity value from a specific manufacturer for a specific millboard product.

Typical thermal conductivity values can range from:

$$k = 0.21 \text{ (Btu) (inch) / (foot}^2\text{) (hour) (°F)}$$

to

$$k = 0.84 \text{ (Btu) (inch) / (foot}^2\text{) (hour) (°F)}$$

Thus the necessity for product specific thermal conductivity.

Note that the lower the algebraic value of "k", the lower the thermal conductivity and the less heat per given time that is transferred across the *floor protector*.

Note that in the following discussions it is necessary to maintain consistent dimensions - i.e.; in dealing with the thickness of materials, do not mix feet with inches, but rather keep all dimensions in inches.

COMPLIANCE

If the manufacturer of the appliance specifies an acceptable material and thickness for floor protection it is necessary, utilizing that specific material with specific thermal conductivity, k, to meet or exceed the thickness specified in order to assure compliance with the listed floor protection requirements of the appliance.

ESTABLISHING EQUIVALENCY

If it is determined that another material of different thermal conductivity is desired to be utilized for floor protection (i.e., perhaps for aesthetic reasons or in order to minimize the thickness of the floor protector) and noting that the thermal conductivity, k, is linear as a function of thickness (for a given single material) then:

$$k_1/t_1 = k_2/t_2,$$

where:

k = thermal conductivity in (Btu) (inch) / (foot²) (hour) (°F) and

t = thickness in inches

and therefore knowing any three of the variables of k and t allows one to solve for the remaining variable; i.e., :

Knowing k_1, t_1 and t_2, one can solve for k_2:

$$k_2 = (k_1)(t_2)/(t_1)$$

Knowing k_1, t_1 and k_2, one can solve for t_2:

$$t_2 = (k_2)(t_1)/(k_1)$$

COMPOSITE FLOOR PROTECTOR ASSEMBLIES

When an assembly consists of more than one material, the assembly is defined as a composite "material".

When a floor protector is constructed of more than one material; i.e., some form of backer board with decorative tile over, it is helpful to first establish the thermal resistance, r, of each material as thermal resistances may be directly added together and then convert the resulting total R to an equivalent thermal conductivity.

$$r = \text{(foot}^2\text{) (hour) (°F)/(Btu) (inch)} \text{ and;}$$

$$R = (r)(t)$$

where r is for a particular material in the composite and t is the thickness of that particular material.

Thus for the two-material example of backer board plus decorative tile,

$$R_{\text{total}} = R_{\text{backer Board}} + R_{\text{decorative tile}}$$

and;

$$R_{\text{backer board}} = (r_{\text{backer board}})(t_{\text{backer board}})$$

and;

$$R_{\text{tile}} = (r_{\text{tile}})(t_{\text{tile}})$$

RELATIONSHIP BETWEEN k AND R

By definition:

$$R = (1/k)(t) \text{ for each distinct material}$$

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APPENDIX L

SCHEDULE OF FEES

L 1.0 Fee Schedule: In accordance with the authority conferred by M.G.L. c 143, § 94, the State Board of Building Regulations and Standards hereby establishes the following fees as specified in Table L-1.

Exceptions:

1. Fees for projects which are under the jurisdiction of a city or town shall be as duly established by said city or town in accordance with 780 CMR 114.0.
2. Fees for construction related licenses issued by a city or town shall be in accordance with fee schedules established by said city or town.
3. Fees for administrative appeals hearings in cities of towns having duly established building code appeals boards in accordance with 780 CMR 122 shall be as established by said city or town.

Table L-1

Fee Item	Period of Certification or Licensure	Fee (Dollars)	780 or M.G.L. Authority or Reference
Concrete Testing Laboratory			**780 CMR R1**
Initial license	One year	150.00	780 CMR R1.1.8
Renewal	One year	150.00	780 CMR R1.1.10
Concrete Test Technician - Class A			780 CMR R2
Initial license	One year	50.00	780 CMR R2.1.9
Renewal	One year	50.00	780 CMR R2.1.11
Initial license & Renewal Fees for employees of: municipalities, counties, Federal Government, Commonwealth of Massachusetts or any department, commission, agency or authority of, or created by the Commonwealth	One year	No Fee	780 CMR R2.1.9
Examination	Per exam	Note 1	780 CMR R2.1.7
Manufactured Buildings			780 CMR R3
Manufacturer - initial certification (per system)	One year	1200.00	780 CMR R3.18.1
Manufacturer -renewal of certification	One year	650.00	780 CMR R3.18.3
Labels per unit	Per label	50.00	780 CMR R3.18.4
Replacement label	Per label	2.00	780 CMR R3.18.4
Labels per component	Per label	2.00	780 CMR R3.18.4
Inspection Agency - initial certification	One year	500.00	780 CMR R3.18.2
Inspection Agency - certification renewal	One year	500.00	780 CMR R3.18.3
Registration of Producers of Native Lumber			780 CMR R4
Initial registration fee	Two years	50.00	780 CMR R4.1.4
Registration renewal	Two years	25.00	780 CMR R4.1.5
Construction Supervisor License (CSL)			780 CMR R5
Unrestricted license (any building enclosing up to 35,000 cubic feet of space)			
Initial license	Three years	150.00	780 CMR R5.2.5
Renewal	Two years	100.00	780 CMR R5.2.5
Examination fee	Per exam	Note 1	780 CMR R5.2.5
Restricted License (one and two family dwellings)			
Initial license	Three years	150.00	780 CMR R5.2.5
Renewal	Two years	100.00	780 CMR R5.2.5
Examination fee	Per exam	Note 1	780 CMR R5.2.5
Restricted License - Masonry only			
Initial license	Three years	150.00	780 CMR R5.2.5
Renewal	Two years	100.00	780 CMR R5.2.5
Examination fee	Per exam	25.00	780 CMR R5.2.5

Fee Item	Period of Certification or Licensure	Fee (Dollars)	780 or M.G.L. Authority or Reference
Home Improvement Contractor Registration			M.G.L. c 142A & 780 CMR R6
Initial Certification (applicants holding CSL License)	Two years	No fee	
Initial Application (all other applicants)	Two years	100.00	
Renewal (applicants holding CSL License)	Two years	No fee	
Renewal (all other applicants)	Two years	100.00	
Guaranty Fund Payment (upon initial registration - all applicants)			
0-3 employees	Note 2	100.00	
4-10 employees	Note 2	200.00	
11-30 employees	Note 2	300.00	
over 30 employees	Note 2	500.00	
Certification of Building Commissioners, Inspectors of Buildings and Local Inspectors.			M.G.L. c 143 § 3 & 780 CMR R7
Certification fee		no fee	
Examination registration		Note 1	
Continuing education programs provided directly by the Board of Building Regulations and Standards		Reserved	
State Building Code Appeal Board			M.G.L. c 143 § 100
Administrative Hearing	Per hearing	150.00	780 CMR 122.3.1
Structural Peer Review Advisory Board			780 CMR 125
Mediation Hearing		No fee	780 CMR 125.3
Building Permits and Construction Inspection for State Projects (except Massachusetts Bay Transportation Authority Projects) subject to 780 CMR and under the jurisdiction of the Department of Public Safety, Division of Inspections.			M.G.L. c 143 §§ 93 & 94 M.G.L. c 143 § 3A
Plans examination, construction inspection, issuance of building permit and certificate of and occupancy	Per building or structure.	0.001 times the contract amount (Note 3)	M.G.L. c 143 §§ 93 & 94
Note: This fee structure shall be deemed to include, but not be limited to, electrical, plumbing mechanical and fire protection work. Fees shall not be permitted to be levied by local jurisdictions.			
Massachusetts Bay Transportation Authority Projects			M.G.L. c 161A § 18
Massachusetts Bay Transportation Authority Projects subject to 780 CMR.		No fee	M.G.L. c 161A § 18
Periodic Inspections of Existing Buildings under the jurisdiction of the Division of Inspections, Department of Public Safety			780 CMR 106.5 & M.G.L. c 111
Hospitals and Clinics (certificate of inspection)			
First 100 beds	Two years	50.00	M.G.L. c 111§ 51
Each additional 25 beds	Two years	10.00	
Infirmaries; Convalescent Homes; Nursing Homes; Charitable Homes for the Aged; Rest Homes; Intermediate Care Facilities for the Mentally Retarded. (certificate of inspection)	Two years	50.00	M.G.L. c 111 § 71

Fee Item	Period of Certification or Licensure	Fee (Dollars)	780 or M.G.L. Authority or Reference
Periodic Inspections of all other existing buildings.			M.G.L. c 143 § 94
Periodic inspections of specified use groups as specified by 780 CMR 106.5 and Table 106	As specified by 780CMR Table 106	As specified by 780CMR Table 106	780 CMR 106.5 and Table 106
Certification of Building Commissioners, Inspectors of Buildings, and Local Inspectors			M.G.L c.143 § 94 & § 99 & 780 CMR R7
Certification Preparation Course of Instruction		zero – 500.00 See Note 4	M.G.L c.143 § 94 & § 99 & 780 CMR R7 & the General Appropriation Act
Building Code Training			
One to Two Hour Session	....	zero - 25.00 See Note 4	"
½ Day Training Session	....	zero - 50.00 See Note 4	"
1 day Training Session	....	zero - 100.00 See Note 4	"
Multi Session Training	....	zero - 1000.00 See Note 4	"
Subscription to "Codeword" Educational Newsletter	1 year	16.00	"

Notes:

1. Examination fees established by examining institution.
2. M.G.L. c 142 A § 11 provides that additional payments into the guaranty fund may be required if the fund administrator determines that the amount of the fund is insufficient to maintain it at a level commensurate with claims made against said fund.
3. Contract amount, for the basis calculation of permit fees, shall include the entire scope of work of the project and shall include all incidental constructions. Contract amount, for the basis of calculation of permit fees, shall not be deemed to include design fees or any other professional fees associated with construction observation or supervision or construction management.
4. Fees for continuing education of building officials and building code training will be established by the agency and may vary due to costs associated with each individual training session. Cost of materials, space rental, and contracted instructors, may influence fees.

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780 CMR R1

CONCRETE TESTING LABORATORIES LICENSING

780 CMR R1.1 ADMINISTRATION

R1.1.1 Title As authorized by M.G.L. c. 143, §§ 93 through 100, and in accordance with 780 CMR 123.0, establishing the Construction Materials Safety Board,780 CMR R1 is adopted for Licensing of Concrete Testing Laboratories.

R1.1.2 Definitions Unless otherwise expressly stated in 780 CMR, the following terms shall, for the purpose of 780 CMR R1, have the meaning indicated in 780 CMR R1.2:

Accredited Laboratory: A laboratory which has been licensed in accordance with 780 CMR R1 by the BBRS.

BBRS: State Board of Building Regulations and Standards

Board: Construction Materials Safety Board (CMSB).

Branch Laboratories: A branch of a Testing Laboratory physically removed from the location of the headquarters or main testing facility of the Testing laboratory.

Laboratories: Testing laboratory, branch laboratory, and project laboratory.

Person: Individual, partnership, corporation, trust, joint venture, etc.

Pre-Qualifying Agency: Construction Materials Safety Board (CMSB).

Project Laboratory: A temporary on-site facility providing concrete testing services for a specific project under the direction of a testing or branch laboratory licensed by the Commonwealth of Massachusetts.

Testing Agency: National Institute of Standards and Technology (NIST), Cement and Concrete Reference Laboratory (CCRL), the Army Corps of Engineers, or other agency designated by the BBRS.

Testing Laboratory: A proprietorship, corporation, partnership or agency which conforms to the requirements of ASTM E 329-72 as modified in 780 CMR R1.

R1.1.3 Licensing All laboratories defined by 780 CMR R1.1.2 as Testing Laboratories, Branch Laboratories and Project Laboratories which are engaged in the testing of concrete and concrete materials for use in buildings and structures subject to control according to the provisions of 780 CMR 116 will be licensed by the BBRS in accordance with 780 CMR R1.

R1.1.4 Application for Licensing Each laboratory desiring to obtain such license shall make application to the BBRS upon such form and in such manner as the BBRS shall prescribe and shall furnish evidence satisfactory to the BBRS that the laboratory equipment meets the requirements of 780 CMR R1.2 and its management personnel are qualified in accordance with 780 CMR R1.4 and .5. Such application shall also include payment of the licensing fee set forth in 780 CMR R1.1.8.

R1.1.5 Pre-qualifying Agency The BBRS hereby designates the Construction Materials Safety Board as its Pre-Qualifying Agency, provided, however, that the BBRS may revoke such designation at any time, and may designate any other agency or agencies which it deems qualified, from time to time, to act as its Pre-Qualifying Agency. The Pre-Qualifying Agency shall examine, or cause to be examined, the evaluation performed by the Testing Agency and the personnel on each Concrete Testing Laboratory application and make its recommendation to the BBRS regarding such license.

R1.1.6 Testing Agency The BBRS hereby designates the Cement and Concrete Reference Laboratory of the National Institute of Standards and the Army Corps of Engineers as the agencies to examine and evaluate all laboratories desiring to be licensed in the practice of concrete testing, provided, however, that the BBRS may revoke such designation at any time, and may designate any other agency or agencies which it deems qualified, from time to time, to act as its Testing Agency.

R1.1.7 Notification of Testing and Testing Results The Testing Agency shall notify the applicant of the date for evaluation and shall provide the audited laboratory with a report of audit findings.

Note: Unless specific permission has been granted by the BBRS, accredited laboratories must have the capability to test both concrete and concrete aggregate.

R1.1.7.1 Audit findings response: The audited laboratory shall request that the testing agency forward a copy of the audit report to the BBRS.

The audited laboratory shall prepare formal responses to each and all audit findings and issue such response report to the BBRS for reviewt. (Also see 780 CMR R1.3

R1.1.8 Licensing Fee The fee for licensing shall be $150.00 per annum or in accordance with the fee schedule established by the BBRS from time to time.

R1.1.9 Number and Classification Each laboratory so licensed by the BBRS shall be issued a number and classification.

R1.1.10 Renewals Commencing January 1, 1978, all licenses issued shall expire on December 31 of the year issued. Within 60 days before the expiration date of any such license, the Administrator of the BBRS shall forward to each laboratory so licensed an application form for renewal. Said renewals shall be returned to the BBRS by December 31. The said Administrator, upon receipt of the completed form and fee, shall renew the license for a period of one year or notify such applicant of the BBRS's refusal with reasons thereof.

R1.1.11 Penalties Any such person and/or laboratory who fails to comply with the requirements of 780 CMR R1 or who files a false report shall be subject to the penalties and actions as prescribed in 780 CMR 118.

780 CMR R1.2 LABORATORY LICENSING REQUIREMENTS

R1.2.1 ASTM Testing Requirements Except as modified in 780 CMR R1, all testing laboratories including branch laboratories shall conform to Sections 5 and 6 of the ASTM E 329-72 standard requirements for testing of concrete and its constituent materials.

> **Exception**: The following sections of ASTM E 329-72 shall not apply:
> Sections 2.2; 2.3; 2.7; 3.2.7; 3.3; 3.4 C360 of 6.2; 7; 8; 9 and 10.

R1.2.2 ASTM Equipment and Personnel Requirements: All laboratories subject to 780 CMR R1 shall be approved and licensed in accordance with the ASTM E 329-72 standard for the performance of those functions recommended in standard ASTM E 329-72, for equipment and personnel, as modified in 780 CMR R1.

780 CMR R1.3 PRE-QUALIFICATION REQUIREMENTS FOR LABORATORIES

R1.3.1 Evaluation:

a. Testing and branch laboratories subject to 780 CMR R1 shall be examined and evaluated, upon notification from the BBRS, by a testing agency designated by the BBRS. The interval between such examination and evaluation shall not exceed three years.

b. Project laboratory equipment which is used in the testing of concrete materials for use in buildings and structures subject to the provisions of 780 CMR shall conform to the requirements of ASTM E 329 as modified by 780 CMR R1.2.

c. Reports of evaluations by the testing agency shall be filed with the BBRS within ten days of receipt of the report by the laboratory, unless a waiver is granted by the laboratory to have the report sent directly to the BBRS by the testing agency.

d. Laboratory deficiencies cited in the report of the testing agency shall be corrected within 30 days of the date of issue of the report and shall be so certified by an affidavit submitted by the laboratory on a form supplied by the BBRS.

R1.3.2 Review of Deficiencies: Laboratories which fail to meet the requirements of 780 CMR R1.3.1 items c. and d. shall be subject to review and revocation of their license by the BBRS.

R1.3.3 Testing Machines: Compression testing machines used for testing materials subject to 780 CMR R1 shall be calibrated and verified, with equipment traceable to the National Institute of Standards and Technology (NIST), at least annually or as required by the BBRS, and the results submitted to the BBRS.

780 CMR R1.4 PERSONNEL

The management and supervision of each laboratory subject to 780 CMR R1 shall be in accordance with the following requirements:

R1.4.1 Required: Each accredited licensed Concrete Testing Laboratory must have an individual approved by the BBRS in each of three distinctly different categories: Director of Testing Services, Supervisory Laboratory Technician and Supervisory Field Technician. An individual may fill more than one position at the particular laboratory if he meets all the qualifications for each position, but he may not fill positions concurrently at a separate (branch or project) laboratory. The project laboratory must have a full-time resident supervisory laboratory technician qualified in accordance with 780 CMR R1.

R1.4.2 Filing of Qualifications: Each individual being certified for a position must submit his or her credentials and qualifications under penalty of perjury with signature notarized. Individuals applying for certification in more than one category must file separate applications for each position as described in 780 CMR R1.5. Application for certification shall be filed within 30 days of employment for such duties. It is the responsibility of the Director of Testing Services to notify the BBRS within seven days of any vacancy of any position. Any vacant position shall be filled within 30 days.

780 CMR R1.5 QUALIFICATIONS

R1.5.1 Qualifications for Director of Testing Services: The testing services of each laboratory (main, branch or project) shall be under the direction of a Director of Testing Services who shall be a full-time resident employee of that laboratory and shall be qualified in accordance with any one of the following three sets of requirements:

a. He or she shall be a Professional Engineer, registered in the Commonwealth of Massachusetts with a least five years of experience in responsible charge of work related to Structural Engineering, Construction Engineering or Construction Materials Testing. He shall be subject to demonstrate his ability to interpret the results of tests of concrete and concrete aggregates as stated in ASTM E 329-72; or,

b. He or she shall have a Bachelor's Degree in Engineering from an accredited institution and an additional total of three years experience performing tests on concrete and concrete materials which shall include two years as a laboratory technician or supervisor. He or she shall be subject to demonstrate his ability to interpret the results of tests of concrete and concrete aggregates as stated in ASTM E 329-72; or

c. He or she shall have at least eight years experience including five years experience as a laboratory technician or supervisor and shall be subject to demonstrate his ability to interpret the results of tests of concrete and concrete aggregates as stated in ASTM E 329-72.

R1.5.2 Qualifications for Supervisory Laboratory Technician: A Supervisory Laboratory Technician shall have at least five years' experience performing tests on construction materials including concrete and concrete aggregates. He or she shall be subject to demonstrate his ability to perform correctly tests of concrete and aggregates as stated in ASTM E 329-72. "Class A" accreditation by the Pre-Qualifying Agency shall be required as qualification for concrete only. (See 780 CMR R2 Concrete Testing Personnel Licensing Rules and Regulations.)

R1.5.3 Qualifications for Supervisory Field Technician: A Supervisory Field Technician shall have at least five years experience performing tests on construction materials including concrete. He or she shall be subject to demonstrate either by oral or written examination, or both, his ability to perform correctly the tests of concrete as stated in ASTM E 329-72. "Class A" accreditation by the Pre-Qualifying Agency shall be required as qualification for concrete only. (See 780 CMR R2 Concrete Testing Personnel Licensing Rules and Regulations.)

780 CMR R1.6 PROJECT AFFIDAVIT

In accordance with 780 CMR 110.12, those structures subject to control as required in 780 CMR 116, affidavits must be submitted with the building permit application that the individuals and testing laboratories responsible for carrying out the duties of 780 CMR 116 have been licensed and registered by the BBRS.

R1.6.1 Affidavit: In accordance with 780 CMR R1.6, an affidavit shall be furnished to the building department by the licensed laboratory and shall be provided by the licensed laboratory for each building project.

R1.6.2 Notice of Termination: The building official shall receive written notification of the termination of laboratory functions certifying that the owner has also been so notified. Such termination shall be effective no earlier than three working days from the notification received by the building official.

R1.6.3 Successor Laboratory: If concrete testing is to be continued for the said project by a successor laboratory, such notice shall be given to the building official and a new project affidavit shall be filed with the building official.

780 CMR R1.7 REVOCATION AND SUSPENSION PROCEDURES

R1.7.1 Revocation and Suspension: The BBRS on its own initiative or upon the recommendation of the Construction Materials Safety Board may suspend or revoke the license of any Testing Laboratory or Project Laboratory found to be in noncompliance with 780 CMR R1, 780 CMR, or the Standards of good practice. Notice of suspension or revocation of such license shall be in writing with the reasons for suspension or revocation clearly set forth therein, and served in accordance with 780 CMR 118.6.

R1.7.2 Notice and Conference: Prior to suspension, revocation, or refusal to renew the license of an accredited laboratory, written notice of such intent shall be served by the Construction Materials Safety Board of BBRS in accordance with 780 CMR 118.6. Within ten calendar days of receipt of such notice, the affected accredited laboratory may request a conference before a three member panel designated by the Chairman of the Construction Materials Safety Board; said panel will hear facts and make their recommendations to the Construction Materials Safety Board, who in turn shall report such findings to the BBRS for BBRS consideration and action.

R1.7.3 Effect of suspension or revocation: Upon suspension or revocation of the license, the accredited laboratory shall immediately cease engaging in the testing of concrete and concrete materials for use in buildings and structures which are subject to the provision of 780 CMR 116 and no action brought before the Board of Appeals as specified in

780 CMR R1.8.1 or in any court of competent jurisdiction shall stay the said suspension or revocation unless said Board of Appeals or court shall issue an order for a stay of the BBRS's suspension or revocation.

780 CMR R1.8 APPEALS

R1.8.1 Building Code Appeals Board: Any laboratory or individual aggrieved by the suspension or revocation of their license or by an interpretation, order, requirement, direction or failure to act under 780 CMR R1 may appeal to the State Building Code Appeals Board as provided in 780 CMR 122; however, entry of an appeal from the BBRS's order of revocation or suspension shall not stay such revocation or suspension unless so ordered by the State Building Code Appeals Board in a preliminary hearing conducted expressly for the purpose of a stay in accordance with that part of 780 CMR 122.3.2 dealing with procedure required for a hearing on such stay.

780 CMR R2

CONCRETE TESTING PERSONNEL LICENSING

780 CMR R2.1 ADMINISTRATION

R2.1.1 Title: As authorized by M.G.L. c. 143, §§ 93 through 100, and in accordance with 780 CMR 123.0 establishing the Construction Materials Safety Board, 780 CMR R2 is adopted for Concrete Testing Personnel.

R2.1.2 Definitions: Unless otherwise expressly stated in 780 CMR, the following terms, for the purpose of 780 CMR R2, shall have the meaning indicated in 780 CMR R2.1.2.

BBRS: State Board of Building Regulations and Standards

Board: Construction Materials Safety Board (CMSB)

Concrete Testing Personnel: A person issued a Class "A" license by the BBRS authorizing such person to test/inspect concrete.

Field Concrete Technician: A person issued a Class "A" license by the BBRS to test concrete in the field.

Pre-Qualifying Agency: Construction Materials Safety Board (CMSB)

Testing Agency: Massachusetts Construction Industry Board (MCIB)

R2.1.3 Licensing: All Concrete Personnel engaged in the testing/inspection of concrete for use in buildings and structures subject to control according to the provisions of 780 CMR 116.0 shall be licensed by the BBRS in accordance with 780 CMR R2.

R2.1.4 Application for Licensing: Each person desiring to obtain such license shall make application to the BBRS upon such form and in such manner as the BBRS shall prescribe and shall furnish evidence satisfactory to the BBRS that he is qualified to be licensed in accordance with 780 CMR R2.

R2.1.5 Pre-qualifying Agency: The BBRS hereby designates the Construction Materials Safety Board as its Pre-Qualifying Agency, provided however, that the BBRS may revoke such designation at any time and may designate any other agency or agencies which it deems qualified, from time to time, to act as its Pre-Qualifying Agency. The Pre-Qualification Agency shall examine, or cause to be examined, the examination results and evaluation performed by the Testing Agency on each Concrete Testing Personnel Application and make its recommendation to the BBRS regarding such license.

R2.1.6 Testing Agency: The BBRS hereby designates the Massachusetts Construction Industry Board (MCIB) as the agency to examine and evaluate all persons desiring to be licensed in the practice of concrete testing, provided, however, that the BBRS may revoke such designation at any time, and may designate any other agency or agencies which it deems qualified, from time to time, to act as its Testing Agency. The Testing Agency shall submit all examination results and evaluation on each Concrete Testing Application and make its recommendations to the Pre-Qualification Agency regarding such license.

R2.1.7 Examination: Accompanied by the application, there shall be paid to the Testing Agency an initial examination fee to cover the cost of such testing. The Testing Agency may also assess fees for partial or complete retesting. The Testing Agency is authorized to require the applicant to provide all required test equipment.

R2.1.8 Notification of Examination and Examination Results: The Testing Agency shall notify the applicant of the time and place for the examination. The BBRS shall be informed by the Testing Agency/Pre-Qualifying Agency of the examination results, evaluation and recommendations. Within 14 days therefrom, the BBRS shall notify the applicant of its decision. If the applicant fails fully or partially, he may request of the Testing Agency a retesting. If the applicant is notified by the BBRS that he has met all the requirements herein established, he shall submit to the said BBRS, the license fee in accordance with 780 CMR 2.1.9, and his 1¼" x 1¼", full face, black and white or color photograph.

R2.1.9 Licensing Fee: The fee for licensing shall be $50 in accordance with the fee schedule established by the BBRS. Concrete Testing Personnel employed for that purpose by a municipality or county or the federal government, or the Commonwealth or any department, commission, agency or authority of, or created by, the Commonwealth, shall be exempt from this fee.

R2.1.10 Number and Classification: Each person so licensed by the BBRS shall be issued a number and classification.

R2.1.11 Renewals: Licenses shall be valid for one year and the license renewal fee shall be $50 dollars. Within 30 days before the expiration date of any such license, the Administrator of the BBRS shall forward to each person so licensed an application form for renewal. The said Administrator, upon receipt of the completed form and fee, shall renew the license for a period of two years or notify such applicant of the BBRS's refusal with the reasons thereof. An applicant shall submit a renewal application with fees within one year of the expiration date of the license. Failure to submit a renewal application within this time period shall be cause for examination or re-examination. Upon successful completion of a Class A Technician's examination said applicant is eligible to be licensed upon submittal of an application and fee. Said application and fee shall be submitted within one year of the date of the examination. Failure to acquire a license within this time period shall be cause for examination or re-examination.

780 CMR R2.2 PRE-QUALIFICATION REQUIREMENTS FOR PERSONS DESIROUS OF BEING LICENSED FOR CONCRETE TESTING

R2.2.1 Evaluation: Field Concrete Technicians, subject to 780 CMR R2, shall be examined and evaluated by the Massachusetts Construction Industry Board to determine the applicant's knowledge and ability to perform the following ASTM Standard Test Procedures:

- a. ASTM C172: Sampling Fresh Concrete
- b. ASTM C143: Test for Slump
- c. ASTM C31: Making and Curing Test Specimens in the Field
- d. ASTM C231: Test for Air Content - Pressure Method
- e. ASTM C173: Test for Air Content - Volumetric Method
- f. ASTM C138: Test for Weight per Cubic Foot (Density)
- g. ASTM C192: Storage and Transportation of Test Cylinders

The applicant's performance of these tests is to be observed and evaluated by two qualified jurors designated by the Testing Agency (MCIB), using detailed data sheets. The said jurors' evaluations are appraised by the Certification Committee of the Testing Agency and reappraised by the Board of Trustees of the said Testing Agency. Three categories of performance are to be used in the final evaluation process as follows:

1. PASS: The applicant has satisfactorily completed the examination.
2. PARTIAL: The applicant has failed one of the five performance tests and must take a partial re-test.
3. FAIL: The applicant has failed two or more of the five performance tests and must take a complete re-test.

780 CMR R2.3 REVOCATION AND SUSPENSION PROCEDURES

R2.3.1 Revocation and Suspension: The BBRS on its own initiative or upon the recommendation of the Construction Materials Safety Board or the Massachusetts Construction Industry Board, may suspend or revoke the licenses of any one so engaged in the practice of Concrete Testing found to be in noncompliance with 780 CMR R2, 780 CMR or the standards of good practice. Notice of suspension or revocation of such license shall be in writing with the reasons for suspension or revocation clearly set forth therein, and served in accordance with 780 CMR 118.6.

R2.3.2 Notice of Conference: Prior to suspension, revocation or refusal to renew such license, written notice of such intent shall be served by the Pre-Qualifying Agency or BBRS in accordance with 780 CMR 118.6. Within ten calendar days of receipt of such notice, the affected licensee may request a hearing before a three member panel designated by the chairman of the said agency, who will hear facts and make recommendations to the Pre-Qualifying Agency.

R2.3.3 Effect of Suspension or Revocation of License: Upon suspension or revocation of the license, the licensee shall immediately cease engaging in the testing of concrete and concrete materials for use in buildings and structures which are subject to the provision of 780 CMR and no action brought before the State Building Code Appeals Board as specified in 780 CMR R2.4.1 or in any court of competent jurisdiction shall stay the said suspension or revocation unless said Appeals Board or court shall issue an order for a stay of the BBRS's suspension or revocation.

780 CMR R2.4 APPEALS

R2.4.1 Massachusetts State Building Code Appeals Board Any one engaged in the practice of Concrete Testing aggrieved by the suspension or revocation of their license or by an interpretation, order, requirement, direction or failure to act under 780 CMR R2 may appeal to the State Building Code Appeals Board as provided in 780 CMR 122.0; however, entry of an appeal from the BBRS's order of revocation or suspension shall not stay such revocation or suspension unless so ordered by the said Appeals Board in a preliminary hearing conducted expressly for the purpose of a stay in accordance with that part of 780 CMR 122.3.2 dealing with the procedure required for a hearing on such stay.

MANUFACTURED BUILDINGS, BUILDING COMPONENTS AND MOBILE HOMES

PART I GENERAL

780 CMR R3.1 ADMINISTRATION

R3.1.1Title: The BBRS, Massachusetts Board of Fire Prevention Regulations (Massachusetts Board of State Examiners of Electricians), and the Massachusetts Board of State Examiners of Plumbers and Gas Fitters herewith adopt the Rules and Regulations for Manufactured Buildings, Manufactured Building Components and Manufactured Homes.

R3.1.2 Definitions: Unless otherwise expressly stated in 780 CMR, the following terms shall, for the purpose of 780 CMR R3, have the meaning indicated in 780 CMR R3.1.2:

Approval: Approval by the State Board of Building Regulations and Standards (BBRS)

Building System: Plans, specifications and documentation for a system of manufactured buildings or for a type or a system of manufactured building components, which may include structural, electrical, mechanical, plumbing and fire protection systems and other systems affecting health and safety, including variations which are submitted as part of the building system.

Certification: Any manufactured building, manufactured building component or manufactured home which meets the provisions of the applicable Codes and Rules and Regulations pursuant thereto; and which has been labeled accordingly.

Code: 780 CMR or Specialized Codes as defined herein.

Department - DPS: The Department of Public Safety, Division of Inspections.

Inspection Agency: Independent agency, sometimes referred to as "third-party agency", retained by the manufacturer and approved by BBRS to perform inspections and evaluations of building systems, compliance assurance programs, manufactured buildings, and manufactured building components.

Installation: The process of affixing, or assembling and affixing a manufactured building, manufactured building component or manufactured home on the building site, and connecting it to utilities, and/or to an existing building. Installation may also mean the connecting of two or more manufactured housing units designed and approved to be so connected for use as a dwelling.

Installer of Manufactured Buildings: An individual, who on the basis of training and experience, has been certified by a specific manufacturer of manufactured homes as competent to supervise the placement and connection required to install the manufactured homes of that manufacturer. Said certification by the manufacturer shall be in writing; additionally, the certified installer shall possess picture identification in the form of a driver's license or other picture identification acceptable to the building official.

Label: An approved device or seal evidencing certification in accordance with the applicable Codes and Rules and Regulations promulgated pursuant thereto.

Local Enforcement Agency: A department or agency in a municipality charged with the enforcement of 780 CMR and appropriate specialized codes which include, but are not limited to, 248 CMR (the State Plumbing and Gas Fitting code) and 527 CMR 12.00 (the State Electrical Code) as listed in ***Appendix A***.

Manufactured Building: Any manufactured building which has concealed elements, such as electrical, mechanical, plumbing, fire protection, insulation, and other systems affecting health and safety, and which is manufactured or assembled in accordance with 780 CMR and pertinent regulations, in manufacturing facilities, on or off the building site. Also, any manufactured building as defined above which does not have concealed elements, but which has been approved by the BBRS at the request of the manufacturer. "Manufactured building" does not mean "manufactured home".

Manufactured Building Component: Any manufactured subsystem, manufactured subassembly, or other system designed for use in or as part of a structure having concealed elements such as electrical, mechanical, plumbing and fire protection systems and other systems affecting health and safety.

Manufactured Homes (Housing): As defined in 24 CFR, Part 3280.2; a structure, transportable in one or more sections, which in the traveling mode, is eight body feet or more in width or forty body feet or more in length, or, when erected on site, is 320 or more square feet, and which is built on a permanent chassis and designed to be used as a dwelling with or without a permanent foundation when connected to the required utilities, and includes the plumbing, heating, air-conditioning, and electrical systems contained therein. Calculations used to determine the number of square feet in a structure will be based on the structure's exterior dimensions measured at the largest horizontal projections when erected on site. These dimensions will include all expandable rooms, cabinets, and other projections containing interior space, but do not include bay windows. (See 24 CFR, Part 3280.2 for a more detailed description of manufactured homes as defined by the Department of Housing and Urban Development.)

Specialized Code: All building codes, rules or regulations pertaining to building construction, reconstruction, alteration, repair or demolition promulgated by and under the authority of the various agencies which have been authorized from time to time by the General Court of the Commonwealth of Massachusetts. The specialized codes shall include, but not be limited to, 248 CMR (the State Plumbing and Gas Fitting Code)and 527 CMR 12.00 (the Electrical Code) as listed in ***Appendix A***.

State Administrative Agencies: Boards, commissions, departments or agencies authorized to promulgate, adopt and amend codes and rules and regulations relating to buildings and structures and parts thereof and limited to the BBRS, Massachusetts Board of Fire Prevention Regulations, Massachusetts State Examiners of Electricians, and the Massachusetts Board of State Examiners of Plumbers and Gas Fitters.

State Enforcement Agencies: Boards, commissions, departments or agencies authorized to enforce the provisions of the codes and rules and regulations which have been promulgated, adopted and amended and which relate to buildings or structures and parts thereof and limited to the Department of Public Safety, Massachusetts Board of State Examiners of Plumbers and Gas Fitters, and the Massachusetts State Examiners of Electricians.

R1.3 Scope:

1. 780 CMR R3 shall govern the design, manufacture, handling, storage, transportation and installation of manufactured buildings, and manufactured building components intended for installation in this State and/or manufactured in this State for shipment to any other state in which such building, building components, or manufactured homes and the labels thereon are accepted.
2. The Federal Manufactured Home Construction and Safety Standards promulgated by the Department of Housing and Urban Development govern the design, manufacture, handling, storage and transportation of manufactured homes for installation in this state.
3. Subject to local zoning ordinances and by-laws, manufactured buildings, manufactured building components or manufactured homes may be sold for, delivered to, or installed on, building sites located in any jurisdiction of this State if such buildings, building components or manufactured homes have been approved and certified pursuant to the applicable Codes and 780 CMR R3.

R3.1.4 Administration and Enforcement: The BBRS and the State Enforcement Agencies shall enforce all provisions of 780 CMR R3. The State Enforcement Agencies shall have the responsibility for evaluating and recommending approval to the BBRS of building systems, and for inspecting and recommending certification of manufactured buildings and manufactured building components for compliance with 780 CMR R3 and the applicable codes. The State Enforcement Agencies and the local enforcement agencies shall accept manufactured buildings, manufactured building components, building systems and compliance assurance programs labeled and certified by inspection agencies approved by the BBRS and those manufactured homes certified as in conformance with the Federal standards by the application of the applicable required HUD label.

R3.1.5 Authorization of Third Party Inspections: Upon recommendation of the State Enforcement Agencies, the BBRS may authorize inspection agencies, sometimes referred to as third party inspection agencies, to perform all or part of the inspection and certification of manufactured buildings and manufactured building components, building systems and compliance assurance programs, including either or both the issuance and the attachment of labels thereto. The BBRS may suspend or revoke and such authorization for cause.

R3.1.6 Approvals and Compliance: Upon the recommendation of the State Enforcement Agencies, the BBRS may approve building systems and compliance assurance programs which comply with the codes, standards, specifications and requirements and 780 CMR R3.

R3.1.7 Time of Manufacture: For purposes of 780 CMR R3, a manufactured building, manufactured building component or manufactured home is deemed to be manufactured at such time as the label is attached to it in accordance with the approved compliance assurance program.

R3.1.8 Retroactive Changes: No changes in the codes, standards, specifications and requirements of 780 CMR R3 shall apply retroactively.

R3.1.9 Amendments: The State Administrative Agencies shall notify the BBRS, and the BBRS shall notify all interested parties including State Enforcement Agencies, inspection agencies, manufacturers with approved building systems, and local governmental jurisdictions of all amendments to 780 CMR R3, and each manufacturer shall have no more than 180 days following the sending of notification to submit to the BBRS compliance assurance program revisions in order to comply with such amendments. Where imminent danger to life safety is involved, the State Administrative Agencies may require that immediate effect be given such amendments to the codes, standards, specifications and requirements so adopted.

780 CMR R3.2 COMPLIANCE ASSURANCE PROGRAMS

RR3.2.1 Approval: In order to obtain approval for manufactured buildings or manufactured building components a manufacturer shall submit a building system for evaluation to the BBRS for approvals in accordance with 780 CMR R3.

R3.2.2 Suitability: Prior to a full evaluation, the State Enforcement Agencies shall determine that building systems and/or the application for approval of the compliance assurance program submitted to it are suitable for processing. In the event that the application is found to be unsuitable for processing, the applicant shall be notified in writing of such unsuitability and the basis thereof, within 30 days of the date the application is received by the BBRS. In such event, all but $25 of the fee will be returned and the findings of unsuitability will be without prejudice. Any subsequent submission shall be treated as a new application.

R3.2.3 Requisites: The State Enforcement Agencies may require tests to determine whether a compliance assurance program meets the codes, standards and requirements of the evaluation of plans, specifications and documentation. The procedures used shall be reviewed and evaluated by the BBRS in accordance with 780 CMR R3. The costs of such tests shall be borne by the applicant.

R3.2.4 Notification of Disapproval: In the event a compliance assurance program is disapproved by the BBRS, the BBRS shall notify the applicant with a written explanation of the reasons for such disapproval thereto.

R3.2.5 Approval - Evidence: Approval of a compliance assurance program shall be evidenced by a letter of certification issued by the BBRS.

R3.2.6 Approval - Report: The State Enforcement Agencies shall prepare and the BBRS shall issue to the applicant a building system approval report which shall include therein any conditions imposed for its use.

R2.7 Approval - Variations: A building system and compliance assurance program or any amendment there to which has been approved, shall not be varied in any way without prior written authorization by the BBRS. All amendments shall be in writing and shall be made a part of the written record of the approval.

R2.8 Amendments - Proposed: Amendments to compliance assurance programs may be proposed by submitting to the BBRS for its approval, appropriate plans, specifications, or documentation showing the effect of the proposed amendment on each building system and the required fee.

R3.2.9 Compliance Assurance Program: A manufacturer shall obtain approval from the BBRS of a compliance assurance program for his building system. Buildings or building components shall be manufactured in accordance with an approved program in order to be certified. Compliance assurance programs shall be submitted to the BBRS for its approval in accordance with 780 CMR R3.

780 CMR R3.3 CERTIFICATION

Manufactured buildings or manufactured building components or manufactured homes, accepted by the State Enforcement Agencies and an inspection agency as having been manufactured according to an approved building system and an approved compliance assurance program, shall be certified by the BBRS upon the recommendation of the State Enforcement Agencies as complying with the requirements of the applicable codes and 780 CMR R3. Certification shall be evidenced by the attachment of a label to each certified manufactured building or manufactured building component (or groups of components).

R3.3.1 Manufacturer's Data Plate:

R3.3.1.1 Contents: The following information shall be placed directly or by reference on one or more permanent manufacturer's data plates in the vicinity of the electrical distribution panel, or in some other designated location acceptable to the State Enforcement Agencies, on the manufactured building or manufactured building component where it will be readily accessible for inspection:

a. Manufacturer's name and address;
b. Serial number of the unit;
c. Label serial number;
d. Name and date of applicable building, plumbing, gas and electrical codes and issue of their accumulative supplements complied with;
e. Model designation and name of manufacturer of major factory-installed appliances;
f. Identification of permissible type of gas for appliance and directions for water and drain connection;
g. Snow, wind, seismic and other live loads;
h. Electrical ratings - instructions and warnings on voltage;
i. Special conditions or limitations on use of the units, including unsuitability for areas in which specified environmental conditions prevail;
j. Methods of assembly or joining multiple units;
k. Type of construction, including fire rating, occupancy class, and interior finish flame spread class;
l. Building height and story limitation;
m. Floor area; and
n. Minimum side yard requirements for fire rating.

If, in the opinion of the State Administrative Agencies, the shape or size of a building component is such that this information cannot be attached to it permanently, the information may be placed in a manual crated with the component or on a tag attached to the crate in which the component is shipped, if the information is not such that the future occupant of the building should know it. If the occupant will need to know the information, it shall be contained in a manual which shall be presented to the occupant upon transfer of possession. If life safety is involved, the item in question shall be plainly labeled.

R3.3.2 Labels: Each manufactured building or manufactured building component which is certified pursuant to the applicable codes and 780 CMR R3, shall have permanently attached thereto, in a visible location as shown on the approved building system, an approved label which cannot be removed therefrom without destroying such label.

R3.3.2.1 Contents: An approved label shall bear the following information:

a. "This label certifies that this building (or building component) has been manufactured in accordance with an approved building system and compliance assurance program approved by the Commonwealth of Massachusetts Board of Building Regulations and Standards and inspected by ________________________.";
b. Label serial number;
c. Building system approval number;
d. Manufacturer's serial number;
e. The words "See data plate located on ________________."; and
f. Date of manufacture.

At the direction of the BBRS labels and data plates may be limited in size and content for components whose shape and size does not permit the full information to be placed thereon.

R3.3.2.2 Issuance: The approved label shall be issued by the BBRS or its agents in accordance with the following:

a. If the BBRS delegated the issuance of labels to an inspection agency, the agency shall be required to obtain approval from the BBRS for the manner in which they are handled;
b. Labels must be serially numbered;
c. A manufacturer's compliance assurance program submitted in accordance with 780 CMR R3 shall include requirements for issuance, possession of, attachment of and accounting for all labels to assure that labels are attached only to manufactured buildings, manufactured building components, or manufactured homes manufactured pursuant to an approved building system and inspected pursuant to an approved compliance assurance program; and
d. Upon request of the inspection agency, the BBRS may determine that the manufacturer's record of compliance is such that the inspection agency need not maintain an inspector in a given plant at all times, inspection agency may entrust labels to the custody of one or more employees of the manufacturer, who shall be charged with controlling the use of the such labels. Such employees shall not be given custody of more labels than are necessary. If the conditions of custody are violated, the BBRS or an inspection agency shall immediately regain possession of all labels that have not been applied to the manufactured buildings or manufactured building components and shall take such further action with respect to future labeling, as it may deem necessary to assure compliance with the applicable codes and 780 CMR R3.

R3.3.3 Records of Labels: Permanent records shall be kept of the handling of all labels, indicating at least how may labels have been applied to manufactured buildings or manufactured building components (or groups of components), which labels have been applied to which buildings or building components, the disposition of any damaged or rejected labels, and the location and custody of all unused labels. Such records shall be maintained by the manufacturer or by the inspection agency. A copy of such records covering attachment of each label shall be sent to the BBRS on the tenth of each month and the BBRS shall forward all such records to the State Enforcement Agencies.

R3.3.4 Attachment of Labels: The inspection agency shall attach in numerical sequence labels to manufactured buildings or manufactured building components manufactured in accordance with an approved building system and meeting the requirements of an approved compliance assurance program.

Manufacturers shall attach labels in the same manner to manufactured buildings or building components manufactured in accordance with an approved building system and meeting the requirements of an approved compliance assurance program.

Manufacturers shall attach labels in the same manner to manufactured buildings or building components manufactured in accordance with a approved compliance assurance program, if custody of the labels has been entrusted to them in accordance with 780 CMR R3.3.3.4.

R3.3.5 Suspension and Revocation: The BBRS may suspend or revoke, or cause to be suspended or revoked, the certification of any manufactured building or manufactured building component which the State Enforcement Agencies or an inspection agency finds not to comply with the applicable codes or 780 CMR R3, or which has been manufactured pursuant to a building system or a compliance assurance program for which approval has been suspended or revoked, or which has not been manufactured in accordance with the approved compliance assurance program. The State Enforcement Agencies or an inspection agency shall remove or cause to be removed, labels from any such manufactured building, manufactured building component or manufactured home until it is brought into compliance with the applicable codes and 780 CMR R3. Notice of suspension or revocation of certification shall be in writing with the reasons for suspension or revocation clearly set forth therein.

a. Upon suspension or revocation of the approval of any building system or compliance assurance program, no further labels shall be attached to any manufactured buildings or manufactured building components manufactured pursuant to the building system or compliance assurance program with respect to which the approval was suspended or revoked. Upon termination of such suspension or revocation, labels may again be attached to the manufactured building or manufactured building components manufactured after the date approval was reinstated. Should any building or building component have been manufactured during the period of suspension or revocation, it shall not be labeled unless the State Enforcement Agencies or inspection agency have inspected such building or building component and is satisfied that all requirements for certification have been met. If the State Enforcement Agency acts under 780 CMR R3.3.5, it must notify the inspection agency.

b. The manufacturer shall return all labels allocated for a manufactured building or manufactured building component to the BBRS no later than 30 days from the effective date of any suspension or revocation of the State Enforcement Agencies or inspection agency, of the building system or compliance assurance program pursuant to which the manufactured building or manufactured building component is being manufactured. The manufacturer shall also return to the BBRS all labels which it determines for any reason are no longer needed.

R3.6 Variations of Certified Units: Manufactured buildings, manufactured building components or manufactured homes certified and labeled pursuant to the applicable codes and 780 CMR R3 shall not be varied in any way prior to the issuance of a certificate of occupancy without resubmission to the BBRS for its approval of the variation and of the unit which includes the variation. The State Enforcement Agencies or an inspection agency shall inspect the manufactured building, manufactured building component or manufactured home wherever it is located and such inspection may include such tests or destructive or nondestructive disassembly as the State Enforcement Agencies or an inspection agency deems necessary to assure compliance with the applicable Codes and 780 CMR R3. Local Enforcement Agencies may be designated by the BBRS or State Enforcement Agencies as inspection agencies for such purposes.

780 CMR R3.4 INSPECTION BY THE STATE ENFORCEMENT AGENCIES OR THEIR AGENTS

The State Enforcement Agencies shall make, or cause to be made, such inspections of the entire processing of manufacturing, certifying, handling, storing and transporting of manufactured buildings or manufactured building components produced pursuant to approved building systems as they deem necessary.

R3.4.1 Inspection of Facilities: As part of the process of evaluating building systems and compliance assurance programs, the State Enforcement Agencies shall inspect, or cause to be inspected, the manufacturing facilities in which the buildings or building components are to be manufactured.

R3.4.2 Inspection According to Compliance Assurance Programs: The State Enforcement Agencies or an inspection agency shall make such inspections as may be required by an approved compliance assurance program, or as may be deemed necessary by the State Enforcement Agencies.

R3.4.3 Inspection of Damaged Components: Prior to the issuance of a certificate of occupancy, the State Enforcement Agencies or an inspection agency shall inspect, or cause to be inspected, certified manufactured buildings or manufactured building components which it determines to have been sufficiently damaged after certification to warrant such inspection and to take such action with regard to such buildings or building components as is authorized hereof, or as is otherwise necessary to eliminate dangerous conditions. The local enforcement agencies may be designated by the BBRS or the State Enforcement Agencies as the inspection agency.

R3.4.3.1 Repairing Damaged Components: The State Enforcement Agencies or an inspection agency shall require manufactured buildings or manufactured building components which are so damaged as to no longer comply with the applicable Codes and 780 CMR R3, to be repaired and made to comply within a reasonable time; or if they are so damaged that they cannot be brought into compliance, the State Enforcement Agencies or inspection agency shall order that the labels be removed from such buildings, building components or manufactured homes. A report under this section shall be filed with the inspection agency, BBRS and State Enforcement Agency.

R3.4.3.2 Irreparably Damaged Components: Irreparably damaged buildings or building components shall be disposed of by the manufacturer.

R3.4.4 Monitoring Inspection Agency: The State Enforcement Agencies or their designated agents shall examine each approved inspection agency, at any reasonable time, and without prior announcement, in order to monitor the reliability of each agency and of its monitoring of each compliance assurance program,. Each such examination shall investigate the adequacy of all procedures used by the agency in monitoring compliance assurance programs including inspection, tests, production methods, process controls, operator performance, materials, receipts, storage and handling, workmanship standards, records and all other activities which implement the compliance assurance program in the manufacturing facility, during transport, on-site, and at critical subcontractors' facilities. The results of such examinations shall be filed with the office of the BBRS. Copies of such reports shall be sent to the inspection agency and the State Enforcement Agencies. Inspection agencies shall be specifically notified by the BBRS of any deficiencies and of the manner and time by which such deficiencies must be eliminated. If deemed necessary by the State Enforcement Agencies an inspection agency's approval may be suspended or revoked by the BBRS as provided herein.

R3.4.4.1 Prior to Approval: Such examinations may also be conducted before approving an inspection agency.

R3..5 Inspection by Disassembly: No inspection entailing disassembly, damage to or destruction of certified manufactured buildings, manufactured building components or manufactured homes shall be conducted except to implement 780 CMR R3.

780 CMR R3.5 LOCAL ENFORCEMENT AGENCY PROCEDURES AND INSPECTIONS

R3.5.1 Issuance of building permits: Upon application and in conformity with the provisions of 780 CMR, the building official shall issue building permits for installation of certified manufactured buildings, manufactured building components or manufactured housing.

R3.5.1.1 Licensed Construction Supervisors and Certified Installers: A construction supervisor, duly licensed in accordance with 780 CMR R5, shall, in accordance with 780 CMR 108.3.5, act as the agent for the owner for the purpose of applying for and obtaining any and all building permits required for the field erection of all one or two family manufactured dwellings subject to the provisions of 780 CMR 35 and applicable 780 CMR R3.

As part of the building permit application process, the licensed construction supervisor shall submit to the building official, in writing, the name of the installer, who shall be duly certified by the manufacturer to install said manufacturer's product, and is identified as a *certified installer of manufactured buildings* (certified installer) by said manufacturer. The certified installer shall be responsible for the safe and proper placement and connection of the manufactured home units in accordance with 780 CMR 35, 780 CMR R3 and specialized codes as listed in ***Appendix A***.

The licensed construction supervisor shall be responsible for the construction of the foundation system, and all pertinent site work, in accordance with 780 CMR 35 and 780 CMR R3 listed in ***Appendix A***. The licensed construction supervisor shall provide at least 48 hours notice to the building official before the placement and connection of such units shall begin An application to local enforcement agencies for an appropriate permit shall, when requested, in addition to any other requirements contain:

R3.5.1.2 Permit Application - Statement of Content: A statement that the work to be performed under such permit is to include the installation of a certified manufactured building, manufactured building component or manufactured home in accordance with the provisions of the applicable codes, the statement to be signed by the applicant or his agent, with the appropriate address.

R3.5.1.3 Permit Application - Building System: A true copy of the approved building system with respect to which the manufactured building or manufactured building component was manufactured or is to be manufactured, where one has not previously been furnished to that local enforcement agency.

R3. 5.1.4 Permit Application - Building System Approval: A copy of the Building System Report, as approved by the BBRS, where it has not previously been furnished to the Local Enforcement Agency.

R3. 5.2 Inspection of Site Preparation and Service Connections: Appropriate local enforcement agencies shall inspect site preparation work including foundations, not within the scope of the approval and certification, and the structural, mechanical, plumbing and electrical connections among units, for compliance with applicable law, rules and regulations.

R3.5.3 Compliance with Instructions: Appropriate local enforcement agencies shall inspect all manufactured buildings, manufactured building components or manufactured homes upon, or promptly after, installation at the building site to determine whether all instructions in the Building System Approval Report or conditions listed on the manufacturer's data plate have been followed.

This may include tests for tightness of plumbing and mechanical systems, and for malfunctions in the electrical system and a visual inspection for obvious nonconformity witlr the approved building system.

R3.5.3.1 Disassembly Prohibited: Unauthorized destructive disassembly of certified buildings and building components and mobile homes shall not be performed in order to conduct such tests or inspections, except as provided in 780 CMR R3.3.4.3, nor shall there be imposed standards or test criteria different from those adopted by the State Enforcement Agencies or specified in the Building System Approval Report, or the "HUD's" Manufactured Home Construction and Safety Standards.

R3.5.3.2 Opening Panels: Nondestructive disassembly may be performed only to the extent of opening access panels and cover plates.

R3.5.4 Noncomplying New Units: Local enforcement agencies shall report to the BBRS in accordance with 780 CMR R3.5.6 any noncomplying manufactured buildings and building components.

R3.5.5 Certificates of Occupancy: Appropriate local inspectors shall issue certificates of occupancy for certified manufactured buildings and manufactured homes containing certified building components which otherwise comply with all the applicable codes, after they have been installed and inspected pursuant to the applicable codes and 780 CMR R3, provided that any manufactured building or manufactured building component found not to comply with the Building System Approval Report or any manufactured home found not to comply with "Hud's" Manufactured Home Construction and Safety Standards shall be brought into compliance before such certificate of occupancy shall be issued.

R3.5.6 Reporting of Violations to Department of Public Safety: When any local enforcement agency is making an inspection and finds violations or suspected violations, it shall report the details of the violations in writing to the BBRS. Where violations are hazardous to occupants, a certificate of occupancy shall not be issued and the building shall not be occupied before such hazards are corrected. If the violations are not hazardous, a temporary certificate of occupancy may be issued.

780 CMR R3.6 FEES

R3.6.1 Deposit for Application to the BBRS: A deposit shall be required upon application to the BBRS to perform any of the functions in 780 CMR R3.

R3.6.2 Establishment of Fees: Fees charged by the BBRS for functions performed shall be in accordance with the fee schedule established by the State Administrative Agencies as specified in 780 CMR R3.18.

780 CMR R3.7 NOTIFICATION OF CHANGES IN NAME, ADDRESS, OWNERSHIP OR LOCATION

R3.7.1 Notification by Manufacturers: Manufacturers shall notify the BBRS in writing within ten days of any of the following occurrences:

a. The corporate name is changed;
b. The main address of the company is changed;
c. There is a change in 25% or more of the ownership interest of the company within a 12 month period;
d. The location of any manufacturing facility is changed;
e. A new manufacturing facility is established; or
f. There are changes in principal officers of the firm.

The BBRS shall notify the State Administrative Agencies of such occurrences.

R3.7.2 Notification by Inspection Agencies: Inspection agencies shall notify the BBRS in writing within ten days of any of the following occurrences:

a. The company name is changed;
b. The main address of the company is changed;
c. There is a change in 25% or more of the ownership interest or control of the company within a 12 month period;
d. The location of any testing facility is changed;
e. A new testing facility is established; or
f. There are changes in principal officers and key supervisory and responsible personnel of the firm.

The BBRS shall notify the State Administrative Agencies of such occurrences.

780 CMR R3.8 PROPRIETARY INFORMATION

All information relating to building systems and compliance assurance programs which the manufacturer or other party considers proprietary shall be so designated by him at the time of its submission, and shall be so held by the State Enforcement Agencies and State Administrative Agencies, except as the State Administrative Agencies determine in each case, that disclosure is necessary to carry out the purposes of the applicable codes and 780 CMR R3.

PART II REQUIREMENTS FOR SUBMISSION OF BUILDING SYSTEMS AND COMPLIANCE ASSURANCE PROGRAMS

780 CMR R3.9 BUILDING SYSTEMS

Building systems shall meet the requirements set forth below to be evaluated for compliance with the standards, specifications and requirements adopted by the State Administrative Agencies.

R3.9.1 General Requirements:

R3.9.1.1 Plans, Specifications and Documentation: Building systems, including all plans, specifications and other documentation, shall be submitted in quadruplicate to the BBRS who shall act as the depository and disburser of all such items. The BBRS shall forward to the appropriate State Enforcement Agencies plans, specifications and documentation for their recommendations.

R3.9.1.2 Form and Fees: Building systems shall be submitted in the form prescribed by the BBRS and shall be accompanied by all required fees.

R3.9.1.3 Identification: All documents submitted with the application shall be identified to indicate the manufacturer's name, office address and address of the manufacturing facility.

R3.9.1.4 Plans Showing Elements: Plans shall be submitted showing all elements relating to specific systems on properly identifiable sheets.

R3.9.1.5 Application - Approved Architect or Engineer: Each building system application shall bear the signature and seal of an approved registered architect or registered professional engineer certifying that the building system complies with the applicable codes and standards promulgated herein.

R3.9.1.6 On-site Work Identified: All work to be performed on-site, including connection of all systems, equipment and appliances, shall be identified and distinguished from work to be performed in the manufacturing facility.

R3.9.1.7 Space for State Administrative Agencies Approval Stamp: A 3" x 4" blank rectangular space shall be provided on all sheets of plans near the title box for the BBRS's stamp of approval.

R3.9.1.8 Material Grade and Quality: Grade, quality and identification of all material shall be specified.

R3.9.1.9 Calculations and Test Reports: Design calculations and test reports shall be specified.

R3.9.1.9.1 Drawings to Scale: Drawings shall be drawn to scale and be legible.

R3.9.1.9.2 Label and Data Plate Location: Drawings shall indicate the location of the approved label and data plate.

R3.9.1.9.3 Drawings Dated and Identified: Drawings shall be dated and identified. The number of sheets in each set shall be indicated.

R3.9.2 Required Construction Details: Building systems for manufactured buildings shall provide or show, but not be limited to, the details listed below including the method of their testing or evaluation, or both. These requirements shall apply to the building systems for building components only to the extent deemed necessary by the State Enforcement Agencies to permit a proper evaluation of the building component.

R3.9.2.1 General:

a. Details and methods of installation of manufactured buildings or manufactured building components on foundations and/or to each other.
b. All exterior elevations.
c. Cross sections as necessary to identify major building components.
d. Details of flashing, such as at openings and at penetrations through roofs and subcomponent connections. Indicate flashing material and gauge to be used.
e. Attic access and attic ventilation.
f. Exterior wall, roof and soffit material as well as finish.

g. Interior wall and ceiling finish material.
h. Fire separation walls.
i. Sizes, locations and types of doors, windows and fire/smoke detectors.
j. Recommended foundation plans, vents and underfloor access.

R3.9.2.2 Building Classification:
a. Occupancy or use.
b. Area, height, and number of stories.
c. Type of construction.
d. Fireresistance ratings.

R3.9.2.3 Space and Fire Safety:
a. Details of fire resistance rated assemblies for all stairway enclosures, doors, walls, floors, ceilings, partitions, columns, roof and shaft enclosures.
b. Detail of Fire Protection Systems.
c. Details as to width of all aisles, exits, corridors, passageways and stairway enclosures.
d. Toxicity and flame spread classification of finished materials.

R3.9.2.4 Structural Detail Requirements:
a. Engineer's calculations of structural members, where appropriate.
b. Structural and framing details of all floors, roof and walls.
c. Details and stress diagrams of roof trusses.
d. Details of reinforcing steel.
e. Complete loading schedule.
f. Column loads and column schedule.
g. Lintel schedule.
h. Size, spacing and details of all structural elements.
i. Grade or quality of all structural elements (lumber, steel, etc.).
j. Elevation of structural elements, walls or sections thereof, providing resistance to vertical loads or lateral forces.
k. Complete details of all structural connections.

R3.9.2.5 Mechanical Detail Requirements:
a. Location of all equipment and appliances. Indicate equipment and appliances listed or labeled by approved agencies.
b. Heat loss and heat gain calculations.
c. Manufacturer's name, make, model, number, BTU, input and output rating of all equipment and appliances, as appropriate, or the equal thereof.
d. Duct and register locations, sizes, and materials.
e. Clearances from combustible material or surfaces for all ducts, flues and chimneys.
f. Method of providing required combustion air and return air.
g. Location of flues, vents and chimneys and clearances from air intakes and other vents and flues.
h. Details regarding dampers in ducts penetrating fire separations.
i. Complete drawings of fire sprinkler system, standpipe system or smoke/fire alarm system as required.
j. Detail of elevator or escalator system, including method of emergency operation.
k. Duct and piping insulation thickness.
l. Ventilation air calculations.

R3.9.2.6 Plumbing Detail Requirements:
a. Plan or schematic drawing of the plumbing layout, including but not limited to, size of piping, fitting, traps and vents, cleanouts and valves, gas, water, and drainage system.
b. Plumbing materials, and location of all equipment and appliances to be used. Indicate fixture unit capacity of system(s) and the make, model, and rating/capacity of equipment and appliances. Indicate equipment and appliances listed or labeled by approved agencies.
c. Make and model of safety controls (such as for water heaters), their location, and whether listed or labeled by approved agencies.
d. How piping is to be supported and intervals of support.
e. Location of vents above roofs and required clearances, including but not limited to clearances from air intakes, other vents and flues.
f. Methods of testing.

R3.9.2.7 Electrical Detail Requirements:
a. Plan of service equipment, including service entrance, conductors, service raceway and clearances above ground and above structures.
b. Method and detail for grounding service equipment.
c. Single line diagram of the entire electrical installation.
d. Load calculations for service and feeders.
e. Sizes of all feeders and branch circuits.
f. Size, rating and location of main disconnect/overcurrent protective devices.
g. Method of interconnection between manufactured buildings or manufactured building components and location of connections.
h. Location of all outlets and junction boxes.
i. Method of mounting fixtures and wiring installations.
j. Lighting power calculations.

780 CMR R3.10 COMPLIANCE ASSURANCE PROGRAMS FOR MANUFACTURED BUILDINGS AND MANUFACTURED BUILDING COMPONENTS

Compliance assurance programs shall be approved if they meet the requirements set forth in 780 CMR R3.3.10. It is the manufacturer's responsibility to execute every aspect of this program. The manufacturer shall continue to be responsible for all corrective actions required and the contractual relationship between the manufacturer and the inspection agency shall not diminish such responsibility. The manufacturer shall cooperate with the inspection agency by providing the inspection agency with all necessary reports, information, documents, records, facilities, equipment, samples and other assistance for assuring compliance.

The manufacturer's compliance assurance program shall be submitted to the BBRS in the form of a compliance assurance manual which shall contain complete documentation of all compliance assurance activities of both the manufacturer and the inspection agency. The manual shall be comprehensively indexed, and shall treat the material listed here in detail, as follows:

R3.10.1 Organization Requirements:

a. A procedure for periodic revision of the manual;

b. An organizational structure for implementing and maintaining the compliance assurance program and its functional relationship to other elements of the organization structure of the manufacturer, which structure shall provide for independence from the production department; Company officers and employees in charge of the compliance assurances program must be identified, and their training and qualifications specified;

c. A uniform system of audit (in-depth analysis of program effectiveness and means to identify deficiencies) to monitor program performance periodically;

d. Complete and reliable records of manufacturing and site operations, if any (suitable means of storage, preservation and accessibility of copies of forms to be utilized shall be included);

e. A system to control changes in production or inspection procedures;

f. A system to assure that working drawings and specifications, working instructions and standards, procurement documents, etc. conform to the approved building system;

g. A serial number system for buildings or building components; and

h. The method of safekeeping, handling and attaching labels and identification of those employees responsible therefor.

R3.10.2 Materials Control

a. Procedure to assure effective control over procurement sources to ensure that materials, supplies and other items used in production and site operations, if any, conform to the approved plans, specifications and quality requirements;

b. Procedures for inspection of materials, supplies and other items at the point of receipt;

c. Method of protection of materials, supplies and other items against deterioration prior to their incorporation in the certified buildings or building component; and

d. Provision for disposal of rejected materials, supplies and other items.

R3.10.3 Production Control:

a. Procedures for timely remedial and preventive measures to assure product quality;

b. Provision, maintenance and use of testing and inspection;

c. Provision for frequency of sampling inspections;

d. Provision of necessary authority to reject defective work and carry out compliance assurance functions, notwithstanding any conflict with production department goals and needs;

e. A schematic of the manufacturing operation showing the location of inspection stations, and "hold" points for mandatory inspection characteristics;

f. Inspection and test procedures, including accept/reject criteria and mandatory inspection characteristics;

g. Standards of workmanship; and

h. Provision of disposal of rejects.

R3.10.4 Finished Product Control:

a. Procedure for final inspection of all manufactured buildings or manufactured building components before shipment to the site or storage point, including identification and labeling;

b. Procedures for handling and storing all finished manufactured buildings or manufactured building components, both at the manufacturing plant or other storage point and after delivery to the building site;

c. Procedures for packing, packaging and shipping operations and related inspections; and

d. Procedures for transportation, including all measures to protect against damage while in transit, and setting forth the modes of transportation to be utilized and the carrying equipment and procedures.

R3.10.5 Installation Control:

a. Installation procedures including component placement, equipment and procedures, field erection and finishing work, utility connection instructions and all appropriate on-site inspection criteria and test descriptions; and

b. Organizational provisions for field repair and disposal of rejects.

R3.10.6 Permission for Inspection: The manufacturer shall provide the BBRS with written permission, signed and notarized, for the State Enforcement Agencies to inspect his manufacturing facilities, his products, and building sites under his control at any reasonable time without prior announcement.

R3.10.7 Inspections by the State Enforcement Agencies: The Compliance Assurance Manual shall contain detailed plans for inspections by the State Enforcement Agencies or inspection agency.

PART III APPROVAL OF INSPECTION AGENCIES

780 CMR R3.11 REQUIREMENTS FOR SUBMISSION

An inspection agency seeking approval shall submit a quadruplicate application to the BBRS which shall include the items listed in 780 CMR 3.11.

R3.11.1 Articles of Incorporation: The original Articles of Incorporation of the agency and all subsequent amendments thereto, as filed in the State of Incorporation.

R3.11.2 By-laws: The by-laws of the organization, if any.

R3.11.3 Business Affiliations of Members: The names, addresses and business affiliations of all members of the Board of Directors and of top management personnel.

R3.11.4 Stock : Individual interests representing more than 10% of the outstanding ownership reflecting the financial interest of the agency's Board of Directors and top management personnel.

R3.11.5 Certifications: Certification by the agency that:

a. Its Board of Directors, as a body, and its technical personnel, as individuals, can exercise independence of judgment; and

b. Its activities pursuant hereto will result in no financial benefit to the agency via stock ownership, or other financial interests in any producer, supplier or vendor of products involved, other than through standard published fees for services rendered.

R3.11.6 Experience of Directors: Names, years of experience, state in which professionally registered and other qualifications of the directors of inspection or evaluation programs.

R3.11.7 Experience of Employees: Names and years of experience of employees practicing in the following disciplines: architecture, structural engineering, mechanical engineering, electrical engineering, fire protection and other branches of engineering; the state in which each is registered and the service each performs.

R3.11.8 Organization Chart: An organization chart showing management and supervisory persons including the number of graduate engineers and architects, and the names of all consulting engineers or architects, designating which are full-time and which are part-time employees.

R3.11.9 Number and Location of Personnel: Number and location of factory inspectors, supervisors, and other technicians, including evaluators of factory inspectors and the qualifications of each specialized group, including records of work experience, licenses held and other pertinent qualifications; description of types of work each group and each technician is expected to perform and the qualifications of each group and each technician to perform the work assigned.

R3.11.10 Employees Training Programs: An outline of the training program, if any, of the agency to assure that all inspectors, evaluators and other technicians are properly trained to do each job assigned to them.

R3.11.11 Employee Supervision: An outline of the general procedures for supervision of inspectors and evaluators, including checking and evaluation of their work.

R3.11.12 Non-employees Relationships: All engineers, technicians and other personnel who will perform services for the organization but who are not employees of the organization, and the supervisory and other relationships which each will have to the agency.

R3.11.13 Products Evaluated:
Type of products, components, equipment, structures and other items which the organization has evaluated, tested or inspected and the number of years of experience the organization has had with each, and the type of codes, standards, specifications and requirements with respect to which the organization has had experience in providing evaluation, inspection or testing services, and the number of years experience with each.

R3.11.14 Frequency Capability: Description of the frequency with which the agency is capable of performing inspections or evaluations.

R3.11.15 State Approved in: List of the states in which the agency is now approved to inspect or evaluate manufactured buildings or manufactured building components or parts thereof for compliance with approved building systems.

780 CMR R3. 12 PROCEDURES FOR APPROVING INSPECTION AGENCIES

R3.12.1 Qualifications: Upon the recommendation of the State Enforcement Agencies, the BBRS may approve inspection agencies which meet the requirements of the applicable codes and 780 CMR 3.0 and which the State Administrative Agencies find otherwise qualified to perform the functions proposed to be delegated to them.

R3.12.2 Suitability of Application: Prior to a full evaluation of an application for approval, the BBRS shall determine whether such application is unsuitable for processing. In the event the application is found to be suitable for processing, the applicant shall be notified in writing of such unsuitability and the basis thereof within 30 days of the date of the application is received by the BBRS.

In such event, all but $25.00 of the fee will be returned, and the rulings of unsuitability shall be without prejudice. Any subsequent submission shall be treated as a new application.

R3.12.3 Approvals: In the event of approval of the BBRS, an inspection agency shall be notified by a letter from the BBRS indicating such approval and stating specifically the functions which the applicant has been approved to perform. Such approval shall not constitute the actual delegation of such functions.

780 CMR R3. 13 SUSPENSION AND REVOCATION

R3.13.1 Grounds: The BBRS may suspend or revoke its approval of any inspection agency if the approval was issued in error; was issued on the basis of incorrect information; was issued in violation of any of the applicable Codes or 780 CMR R3; if the inspection agency violates any of the applicable Codes or 780 CMR R3; if examination discloses that the agency failed to perform properly; or for such other cause as may be deemed sufficient by the State Enforcement Agencies to warrant such action.

R3.13.2 Procedures:

R3.13.2.1 General: If the BBRS suspends or revokes the approval of an inspection agency, the inspection agency shall be given notice in writing from the BBRS of the suspension or revocation with the reasons therefore set forth therein. Manufacturers being evaluated or inspected by such agencies, all local enforcement agencies within this State, and the State Enforcement Agencies shall also be notified in writing of such suspension or revocation. Such notices shall contain instructions to the manufacturer and to the local enforcement agency as to the procedures to be followed regarding manufactured buildings or manufactured building components previously certified by an agency whose approval has been suspended or revoked.

R3.13.2.2 Records: An inspection agency whose approval has been suspended or revoked shall within 90 days of the suspension or revocation deliver to the custody of the BBRS the originals of all records required to be maintained during the course of the inspection agency's operations pursuant to the applicable codes and 780 CMR R3.0

R3.13.2.3 Labels: An inspection agency for which approval has been suspended or revoked shall within 90 days of the suspension or revocation deliver to the custody of the BBRS all labels in the agency's possession, under its control, or for which it is responsible pursuant to the applicable codes and 780 CMR 3.0.

PART IV RECIPROCITY

If the BBRS finds that the standards for the manufacture and inspection of manufactured buildings or manufactured building components prescribed by statute or rules and regulations of another state, governmental agency or private agency meet the objectives of the applicable codes and 780 CMR 3.0, and are enforced satisfactorily by such other state or other agency, or by their agents, the State Enforcement Agencies shall accept manufactured buildings or manufactured building components which have been certified by such other state or other agency, and the BBRS shall assure or be assured that the appropriate label is attached thereto. The standards of another state or agency shall not be deemed to adequately be enforced unless such other state or agency provides for notification to the Department of suspensions or revocations of approvals issued by that other state or agency in a manner satisfactory to the BBRS and State Enforcement Agencies and so notify the BBRS. The BBRS shall notify the State Enforcement Agencies of any action taken under 780 CMR R3.3.13.

780 CMR R3.14 PROCEDURES FOR GRANTING OR REFUSING RECIPROCITY TO ANOTHER JURISDICTION

R3.14.1 Evaluation: The State Enforcement Agencies may evaluate the statute, codes, rules and regulations of another state or other state or other agency at any time.

R3.14.2 Methods of Extending Reciprocity: If the BBRS find that the standards prescribed by the statute or rules and regulations of another state or another agency meet the objectives of the appropriate codes and that 780 CMR 3.0 are satisfactorily enforced, it may upon the recommendation of the State Enforcement Agencies, as provided in 780 CMR 3.2.1, extend reciprocity to that jurisdiction by:

a. Giving notice to any requesting manufacturer;
b. Giving notice to the Administrative Agency of the other jurisdiction;
c. Giving notice to the State Enforcement Agencies and all local enforcement agencies in this state.

R3.14.3 Rejections: If the standards of the other state or other agency do not meet the objectives of the appropriate codes or are inadequately enforced, or both, reciprocity shall not be extended. In that event, the BBRS shall notify any requesting manufacturer and the Administrative Agency of the other state or other agency of the refusal and the reasons therefore.

780 CMR R3.15 PROCEDURES FOR RECIPROCITY CERTIFYING MANUFACTURED BUILDINGS OR BUILDING COMPONENTS

A manufacturer from a jurisdiction to which reciprocity has been extended shall submit to the BBRS evidence that his building system and compliance assurance program have been approved by such state or other agency. The BBRS shall verify the approval and shall notify the State Enforcement Agencies, local enforcement agencies and the manufacturer in writing of such verification and that properly labeled buildings or building components of his manufacture will be accepted.

780 CMR R3.16 SUSPENSION AND REVOCATION

The BBRS shall suspend or revoke, or cause to be suspended or revoked, the acceptance or certification or both of such reciprocally certified manufactured buildings or manufactured building components if the State Enforcement Agencies determine that the standards for the manufacture and inspection of which manufactured buildings or manufactured building components of such other state or other agency do not meet the objectives of the appropriate codes and 780 CMR R3.0, or that such standards are not being enforced to the satisfaction of the State Enforcement Agencies. If such other state or other agency or its agents should suspend or revoke its approval and certification, the acceptance of certification or both granted under 780 CMR 3.16 shall be revoked or suspended accordingly. Notice to the State Enforcement Agencies, local enforcement agencies, manufacturer and to the Administrative Agency of such other state or agency of such suspension or revocation shall be in writing with the reasons for such suspension or revocations set forth therein. Appeals from such suspension or revocations shall receive timely review.

PART V APPEALS

780 CMR R3.17 HEARINGS

All hearings shall comply with the applicable sections of the applicable codes and the Rules and Regulations thereof established for the purpose of appeal.

PART VI SCHEDULE OF FEES

780 CMR R3.18 ESTABLISHMENT

The following is the SCHEDULE OF FEES established by the BBRS for certifying manufactured buildings or manufactured building components. Fees shall be made payable to the "Commonwealth of Massachusetts Board of Building Regulations and Standards" and shall accompany all applications for certification.

R3.18.1 Compliance Assurance Programs and Building Systems: An initial fee of $1,200.00 shall be charged each manufacturer for its certified compliance assurance program for each plant desiring certification. The maximum fee charged under 780 CMR R3.18 shall be $1,200.00 for each manufacturing plant.

R3.18.2 Third Party Inspection Agencies: An initial fee of $500.00 shall be charged to each third party inspection agency.

R3.18.3 Annual Renewal Fees:

a. One year from the date of certification of the manufacturer and every year thereafter certification is in effect, there shall be paid an annual renewal fee of $650.00 for each such certification.
b. One year from the date of certification of the Third Party Inspection Agency, and every year thereafter certification is in effect, there shall be paid an annual renewal fee of $500.00.

R3.18.4 Labels

a. A fee of $50.00 per unit of a manufactured building shall be charged for each label issued by the BBRS.

> **Note**: A "unit" as used in 780 CMR R3.18 shall mean any building or proportion thereof which is towed or shipped separately to be somehow tied together at the site.

b. A fee of $1.00 per building component shall be charged for each label issued by the BBRS for building components.

> **Note**: Manufacturers of building components shall be permitted to use any labels as approved by the BBRS. If such labels are supplied by any source other than the BBRS, there shall be no charge for such labels.

c. Mutilated labels may be replaced at the option of the BBRS at a cost of $2.00 each.

d. Upon satisfactory proof to the BBRS of lost or stolen labels, not the result of negligence, labels may be replaced at a cost of $2.00 each.

e. Labels shall be purchased from the BBRS by the inspection agency or manufacturer.

780 CMR R4

USE OF NATIVE LUMBER

780 CMR R4.1 ADMINISTRATION

R4.1.1 Title: As authorized by St. 1972, 802, and in accordance with 780 CMR 123 establishing the Construction Materials Safety Board, 780 CMR R4 is adopted for Controlling the Use of Native Lumber.

R4.1.2 Definitions: Unless otherwise expressly stated in 780 CMR, the following terms shall, for the purpose of 780 CMR R4, have the meaning indicated in 780 CMR R4.1.2.

BBRS: State Board of Building Regulations and Standards

Board: Construction Materials Safety Board

Native Lumber: Native lumber is wood processed in the Commonwealth of Massachusetts by a mill registered in accordance with the regulations of the BBRS. Such wood is ungraded but is stamped or certified in accordance with the requirements of 780 CMR 2303.1.1. For the purpose this definition, native lumber shall be restricted to use in one-and two-story dwellings, barns, sheds, agricultural and accessary buildings and structures and other uses as permitted by 780 CMR 23.

Person: Individual, partnership, corporation, trust, joint venture, etc.

Wood Producers: Persons or corporations in the business of milling wood into native lumber within the Commonwealth of Massachusetts.

R4.1.3 Registrants: No person shall engage in the producing of native lumber for use in buildings or structures within the Commonwealth of Massachusetts unless registered by the BBRS.

R4.1.4 Application for Registration: Each person desiring to obtain registration as a wood producer of native lumber shall make application to the BBRS upon such form and in such manner as the BBRS shall prescribe and shall furnish evidence satisfactory to the BBRS that he is qualified to be registered in accordance with 780 CMR R4.

R4.1.5 Application Fee: Applications shall be accompanied by a registration fee of $50.00. This initial registration fee shall be for two years. Registration shall be reviewed every two years in accordance with 780 CMR R4. The fee thereafter for a two year renewal shall be $25.00.

R4.1.6 Renewals: Registration shall be valid for two years and shall be renewed biennially. Within 30 days before the expiration date of any such registration, the Administrator of the BBRS shall forward to each person so registered an application form for renewal. The said Executive Director, upon receipt of the completed form and fee, shall renew the registration for a period of two years or notify such applicant of his refusal with reasons thereof. *Any application for renewal of registration which has expired shall require the payment of a new registration fee.*

R4.1.7 Pre-qualifying Agency: The BBRS hereby designates the Massachusetts Wood Producers' Association as its pre-qualifying agency, providing, however, that the BBRS may revoke such designation at any time and may designate any other agency or agencies which it deems qualified, from time to time, to act as its pre-qualifying agency for pre-examination registration.

R4.1.8 Penalties: Any such person who fails to comply with the requirements of 780 CMR 4 or who files a false report shall be subject to the penalties and actions as prescribed in 780 CMR 118.

780 CMR 4. 2 REGISTRATION

4.2.1 Stamp: Each person registered by the BBRS shall be issued a name and number for use in stamping or certifying the native lumber which he produces.

4.2.2 Stamp Contents: Each stamp filed with the BBRS shall be a minimum of two inches by four inches with a minimum of 36 pt. letters and shall contain the following information:

a. Name of native lumber producer;
b. Registration number; and
c. Species of wood.

4.2.3 Stamp Use: Each piece of native lumber produced shall bear the stamp so registered with the BBRS.

4.2.4 Stamp - Unlawful Use: Each registered mill shall be assigned an individual number. It shall be unlawful to use such registration number in any mill other than the mill so registered.

R4.2.5 Stamp - Manufacture: Each producer shall be responsible for the manufacture and use of his stamp in accordance with the requirements of the BBRS and 780 CMR R4.

780 CMR R4.3 REVOCATION AND SUSPENSION PROCEDURES

R4.3.1 Revocation and Suspension: The BBRS on its own initiative or upon the recommendation of the Construction Materials Safety Board may suspend or revoke the registration of any such mill registered in accordance with 780 CMR R4, 780 CMR or the standards of good practice. Notice of suspension or revocation of such registration shall be in writing with the reasons for suspension or revocation clearly set forth therein, and served in accordance with 780 CMR 118.6.

R4.3.2 Notice and Conference: Prior to suspension or revocation of the registration of any such mill so registered, written notice of such intent shall be served by the Construction Materials Safety Board in accordance with 780 CMR 118.6. Within ten calendar days of receipt of such notice, the affected mill may request a conference before a three member panel designated by the Chairman of the Construction Materials Safety Board, who will hear facts and make their recommendations to the Construction Materials Safety Board.

R4.3.3 Effect of: Upon suspension or revocation of the registration of any such mill so registered, such mill shall immediately cease engaging in the stamping or certifying of native lumber. The filing of an appeal with the State Building Code Appeals Board shall stay such suspension or revocation subject to 780 CMR 122.3.2.

780 CMR R4.4 APPEALS

R4.4.1 Building Code Appeals Board: Anyone aggrieved by the decision of the BBRS, the Construction Materials Safety Board, the Massachusetts Wood Producers' Association or others may appeal to the State Building Code Appeals Board in accordance with 780 CMR 122.

780 CMR R4.5 QUALIFICATION

R4.5.1 Evaluation: Evaluation by the pre-qualifying agency shall be required prior to registration of a mill subject to 780 CMR R4. The agency shall examine and evaluate the application of all mills and make its recommendations to the Construction Materials Safety Board. The Construction Materials Safety Board shall make its recommendations to the BBRS who shall act on the application of the mill so requesting registration.

780 CMR R5

CONSTRUCTION SUPERVISORS

780 CMR R5 covers the licensing rules and regulations for construction supervisors as defined in 780 CMR 109.11.

780 CMR R5.1 GENERAL

R5.1.1 Title: As authorized by M.G.L. c. 143, § 94(i), the BBRS herewith establishes the Rules and Regulations for Licensing Construction Supervisors.

R5.1.2 Definitions: Unless otherwise expressly stated in 780 CMR, the following terms shall, for the purpose of 780 CMR R5, have the meaning indicated in 780 CMR R5.1.2:

BBRS: State Board of Building Regulations and Standards

Construction Supervisor: Any individual directly supervising persons engaged in construction, reconstruction, alteration, repair, removal or demolition involving any activity regulated by any provision of 780 CMR. Such term shall also apply to persons supervising themselves.

A licensed *construction supervisor* shall be required for the installation of all manufactured one and two family homes as required by 780 CMR 3508.1.1.

Licensed Designee: Any individual designated by the license holder to be present, in the absence of said license holder, during any of the periods stated in 780 CMR R5.2.12. Such designee shall also hold a *Construction Supervisor's* License, but his name or license number need not be contained on the building permit application.

License Review Committee (Committee): The Committee(s) established by the Chairman of the BBRS to carry out the disposition of complaints against licensed *constructon supervisors*.

Recognition: The approval by the BBRS of an application and related documents by one desirous of being licensed as a *construction supervisor*.

R5.1.3 Scope:

1. 780 CMR R5 shall govern the testing and licensing of individuals who are found to possess the requisite qualifications to be licensed as qualified to have charge or control of construction, reconstruction, alteration, repair, removal or demolition of buildings or structures.
2. Except for those structures governed by Construction Control as regulated by 780 CMR 116.0, any individual directly supervising persons engaged in construction, reconstruction, alteration, repair, removal or demolition involving the structural elements of buildings and structures shall be licensed according to 780 CMR R5.

R5.1.4 Administration and Enforcement: The BBRS shall administer and enforce the provisions of 780 CMR R5. The BBRS or those designated by it, shall administer examinations, under 780 CMR R5, of persons desirous of being registered as qualified to receive a license as a *construction supervisor*.

R5.1.5 License Review Committee: The Chairman of the BBRS shall appoint a License Review Committee, hereafter referred to as the "Committee", which shall consist of any three members of the BBRS who shall serve for one year or until their successors are appointed, whichever is later. The said Chairman shall appoint a Chairman of the Committee who shall serve until his successor is appointed. The Chairman of the BBRS may establish and abolish as many Committees as he/she feels appropriate from time to time.

R5.1.6 Meetings: The Committee shall meet at such times as the Chairman deems it necessary to carry out its function established herein by the BBRS.

R5.1.7 Cities and Towns:

5.1.7.1 Existing Licensed *Construction Supervisors*: (Historical Note) All individuals directly supervising persons engaged in construction, reconstruction, alteration, repair, removal or demolition involving structural elements of buildings or structures who are duly licensed and qualified on January 1, 1981 within any city or town shall be allowed to continue in such capacity under the Rules and Regulations established by such jurisdiction until December 31, 1981. Such duly licensed person shall only be allowed to engage in such practice only within the city or town granting such licensing.

780 CMR R5.2 REGISTRATION AND LICENSING

R5.2.1 Experience: Each applicant for license must prove to the Board that he has had at least three years of experience in building construction or design in the field in which he desires to be licensed, together with any technical knowledge the Board may require him to possess. Successful completion of a three or four year vocational high school or other vocational school program in the field of building construction shall be deemed as satisfying one year of the required three years experience as cited in 780 CMR R5.2.1. (The BBRS shall determine when vocational training other than in building construction, satisfies a portion of the three year experience criteria.

R5.2.1.1 Other Requisites: (Historical Note) Any person who met one of the following requisites shall be licensed by the Board without testing until July 1, 1982.

1. Filed with the BBRS prior to July 1, 1982 an application and applicable documents including an affidavit on a form provided by the BBRS attesting to his meeting the following qualifications:
    a. A registered professional architect or engineer; or
    b. A four-year undergraduate degree in a field related to building construction or design and at least one year, out of the previous ten years, of experience in the supervision of building construction or design; or
    c. At least three years, out of the previous ten years, of experience in the supervision of building construction or design and a general knowledge of the quality and strength of building materials; a general knowledge of the accepted requirements for building construction, fire prevention, light, ventilation and safe exits; and a general knowledge of other equipment and materials essential for safety, comfort and convenience of the occupants of a building or structure.

R5.2.2 Examinations: Examinations shall be held only by appointment. All applications must be filed in accordance with the Massachusetts Construction Supervisor (MACS) Candidate bulletin of Information.

R5.2.3 License Approval: A majority vote of the members of the Board shall be required to grant a license.

R5.2.4 Expiration: Licenses issued pursuant to these rules and regulations shall expire three years from the date of issuance which shall be noted on said license and may be renewed.

A renewal of an original license shall be for periods of two years and a renewal license shall expire two years from the date of issuance which shall be noted on said license and may be renewed.

A renewal license shall not be issued unless application therefore is made within one year of the date of expiration of the most recently issued license. Failure to submit a renewal application and to acquire a license within this time period shall be cause for examination or re-examination.

R5.2.5 Fees: Any and all fees charged for examination, for license fees, or for licensed renewal fees shall be determined by the Commonwealth and enforced by the BBRS. Examination fees are to be established from time to as necessary.

R5.2.5.1 Building Official Fees: The BBRS shall grant a license at no fee to any building official who, as a condition of his employment requires such license; provided that such person meets the necessary qualifications for licensure and provided further, that such license shall be authorized for use only during the course of employment and shall be appropriately stamped to indicate as such.

R5.2.6 Procedure for Obtaining a License:

R5.2.6.1 Application: Applications shall be submitted on forms supplied by the BBRS or its authorized agent.

R5.2.6.2 Forms: The applicable forms may be mailed to the appropriate testing agency as detailed in the Massachusetts Candidates Bulletin (MACS). It shall be the responsibility of the applicant to assure that the required forms are received by the testing agency. All forms shall be accompanied by the required license fee.

R5.2.6.3 Records: The BBRS shall keep a copy of the application and a computer file listing all licensed *construction supervisors*.

R5.2.6.4 Notification of Examination Date: Upon receipt of a fully completed application, an examination date shall be set and the applicant so notified.

R5.2.7 False Statements: Any false statement on the application or references shall be sufficient reason to refuse to issue a license, or to suspend or revoke a license if issued.

R5.2.8 Cause for Suspension or Revocation: Any false statement on the application for license, or in answer to any subsequent request for information, shall be cause for suspension or revocation of license. Any violation of a provision of 780 CMR shall be cause for suspension or revocation of a license as the committee sees fit, or any false statement as identified in 780 CMR R5.2.7, or work performed without a building permit as identified in 780 CMR R5.2.9.1.1

R5.2.9 Procedure for Suspension And/or Revocation of License:

R5.2.9.1 Complaints: Upon receipt of a written complaint from a building official, or upon written complaint from other persons, or upon complaint of the Board itself, the License Review Committee in its discretion, shall determine whether or not a hearing shall be held. It shall not be considered as a complaint if such work was performed prior to his/her being licensed or prior to January 1, 1982, whichever is later.

R5.2.9.1.1 Basis of Complaint: Only work related to a specific building permit shall be the basis of such complaint. Any work requiring a building permit which is performed without such permit shall be considered cause for suspension or revocation.

R5.2.9.2 Hearings on Complaints: If the Committee shall so determine that a hearing shall be held, it shall give at least seven days notice to the complainant and license holder in accordance with 780 CMR 118.6. The sending of notice to the address recorded on the records of the BBRS shall be deemed sufficient notice to the license holder.

R5.2.9.3 Notice of Hearing: The notice of hearing shall contain:

1. The name of the complainant.
2. A copy of the complaint.
3. The date, time and place of said hearing.

The complete file of complaint is available for inspection at the Office of the BBRS during its regular hours.

The license holder may present oral and written evidence to refute or mitigate any charge contained in the complaint and present witnesses in his behalf.

Anyone may be represented by legal counsel.

All license holders shall have his/her license in his possession at the time of the hearing.

R5.2.9.4 Continuation of Hearings: The Committee in its discretion may continue the date for hearing upon request by the license holder or complainant or the Committee itself.

R5.2.9.5 Timing of Decision: The Committee shall make a decision within ten days after the hearing. A written decision shall be issued within 30 days of the hearing date.

R5.2.9.6 Vote of License Review Committee: A vote of at least two members of the Committee is required to make a decision pursuant to 780 CMR R5.2.3.

R5.2.9.6.1 Decisions: This decision shall be final and binding upon the license holder and the complainant. If the Committee votes to revoke or suspend the license of a *construction supervisor* at the time of the hearing, the holder shall immediately surrender said license to the Committee. The committee may, at its discretion, determine that instead of suspension or revocation, the actions of the license holder warrant a letter of warning be placed on file with the BBRS. Said letter of warning will be referenced in the event of future complaints against the license holder. Future complaints against a license holder who has received letter of warning may result in a suspension or revocation of the license after a hearing before the License Review Committee. The Committee may, at its discretion, vote to order the license holder to take the license examination or re-examination. Votes for examination or re-examination may be rendered even if the Committee has voted to suspend, revoke or issue a letter of warning against the license holder.

R5.2.9.7 Suspension, Revocation or Continuance: If, after notice has been duly given, a licensee shall not attend a hearing, the Committee may in its discretion immediately suspend/revoke said license or proceed with the hearing so scheduled and make decision on the evidence so presented, or continue the hearing to another date.

R5.2.9.8 Notice of Suspension, Revocation, Letter of Warning or Order of Examination: In the event that the Committee votes to suspend, revoke or issue a warning against said license holder pursuant to this hearing or, if the Committee votes to require the license holder to take an examination or re-examination, the license holder, upon notice of the decision, shall immediately comply with said orders. A refusal to comply shall automatically revoke the licensee's right to supervise construction.

R5.2.9.8.1 Terms of Suspension: Suspension by the Committee shall be for a definite term.

R5.2.9.8.2 Reapplication: Any licensee whose license has been revoked by the Committee may reapply for a license in accordance with these Rules and Regulations only after seeking and receiving approval to reapply from the Committee.

R5.2.10 Appeal: Any person aggrieved by a decision of the Committee may appeal such decision to a court of law or equity in conformance with M.G.L. c. 30A, § 14.

R5.2.11 Change of Address: The license holder shall have the responsibility of reporting any change of address and/or change of circumstance to the BBRS. The information on file at the BBRS shall be deemed accurate unless changed by the license holder.

R5.2.12 On-site Presence of Supervisor: A licensed individual or a licensed designee shall be present on the site at some point to approve construction, reconstruction, alterations, removal or demolition involving the following work:

1. Excavation
2. Foundation (pouring or other)
3. Decking
4. Rough framing
5. Finished framing
6. Chimneys
   a. Excavation/foundation.
   b. At the top of the smoke chamber and support of the flue liner.
   c. When erection of the chimney is completed.

Exception A licensed *construction supervisor* shall be required for installation of manufactured one and two family homes as required by 780 CMR 3508.1.1.

R5.2.13 Lost/stolen Licenses: License holders are required to keep the license in their possession at all times during the course of construction at any and all building sites. If said license is lost, stolen or mutilated, it shall be the responsibility of the license holder to notify the BBRS.

R5.2.14 Requirement to Show License: Any building official may require the license holder to produce the license at any time on a job site.

R5.2.15 Responsibility of Each License Holder:

R5.2.15.1 Responsibility for Work: The license holder shall be fully and completely responsible for all work for which he is supervising. He shall be responsible for seeing that all work is done pursuant to 780 CMR and the drawings as approved by the Building Official.

R5.2.15.2 Responsibility to Supervise Work: The license holder shall be responsible to supervise the construction, reconstruction, alteration, repair, removal or demolition involving any activity regulated by any provision of 780 CMR only pursuant to 780 CMR and all other applicable Laws of the Commonwealth even though he, the license holder, is not the permit holder but only a subcontractor or contractor to the permit holder.

R5.2.15.3 Notification of Violations: The license holder shall immediately notify the building official in writing of the discovery of any violations which are covered by the building permit.

R5.2.15.4 Willful Violation: Any licensee who shall willfully violate 780 CMR R5.2.15.1, 5.2.15.2 or 5.2.15.3 or any other Sections of 780 CMR R5 and any procedures, as amended, shall be subject to revocation or suspension of license by the Committee.

R5.2.16 Permit Applications: All building permit applications shall contain the name, signature and license number of the *construction supervisor* who is to supervise those persons engaged in construction, reconstruction, alteration, repair, removal or demolition as regulated by 780 CMR 108.3.5 and 780 CMR R5 in the event that such licensee is no longer supervising said persons, the work shall immediately cease until a successor license holder is substituted on the records of the building department.

R5.2.17 GENDER OF TERMS: The term "he" as used in 780 CMR R5 shall include the pronoun "he" and/or "she."

780 CMR R5.3 ADMINISTRATION

R5.3.1 Identification: The BBRS shall issue a card or a certificate or other form of identification.

R5.3.2 Records of Licensees: The BBRS shall maintain a computer listing which will be available to the public at the office of the BBRS containing all licenses issued by the BBRS.

R5.3.3 Examination: The Board shall determine whether an examination shall be required, or shall be oral or written and shall determine the content of the examination, if applicable.

R5.3.4 Subject to Rules, Regulations and Procedures: All persons licensed shall be subject to these regulations as well as other rules, regulations, and procedures promulgated by this BBRS.

R5.3.5 Fees: Any and all fees charged for license fees, examination fees, renewal fees, and registration fees shall be determined by the Commonwealth and enforced by the BBRS. Examination fees shall be established from time to time as necessary.

780CMR R6

REGISTRATION AND ENFORCEMENT OF HOME IMPROVEMENT CONTRACTOR PROGRAM

FORWARD

780 CMR R6 covers the registration of home improvement contractors and subcontractors and enforcement of the requirements of M.G.L. c. 142A as they pertain to home improvement contractors and subcontractors. Other regulations applicable to the Home Improvement Contractor program include:

> **201 CMR 14.00** Operation of the home improvement arbitration program authorized by M.G.L. c. 142A, promulgated by the secretary of the Office of Consumer Affairs and Business Regulations.
>
> **201 CMR 15.00** Operation of the home improvement guaranty fund, promulgated by the secretary of the Office of Consumer Affairs and Business Regulations.

780 CMR R6.1 General Provisions

- R6.1.1 Title
- R6.1.2 Definitions
- R6.1.3 Scope
- R6.1.4 Administration and Enforcement
  - R6.1.4.1 Director responsibility
  - R6.1.4.2 Advisory board
- R6.1.5 Persons Who Must Register
  - R6.1.5.1 Filing of application
  - R6.1.5.2 Designated individual
  - R6.1.5.3 Liability
- R6.1.6 Persons Exempt From Registration

780 CMR R6.2 Registration Procedure

- R6.2.1 Applicant Actions
  - R6.2.1.1 Application
  - R6.2.1.2 Supporting documentation
  - R6.2.1.3 Mailing address
  - R6.2.1.4 Certified check/money order
  - R6.2.1.5 Lost/destroyed certificate
  - R6.2.1.6 Licensee liability
- R6.2.2 Director's Action on Application
  - R6.2.2.1 Issuance of certificate
  - R6.2.2.2 Grounds for refusal to register
  - R6.2.2.3 Application refused
  - R6.2.2.4 Record retention
- R6.2.3 Duration of Registration
- R6.2.4 Fees to be Paid Upon Registration or Renewal
  - R6.2.4.1 Registration and renewal fee
  - R6.2.4.2 Contribution to guaranty fund - initial registration
- R6.2.5 Responsibilities of Each Registrant
  - R6.2.5.1 Changes in status
  - R6.2.5.2 Display of certificate number
  - R6.2.5.3 Return of certificate

780 CMR R6.3 Enforcement Procedure

- R6.3.1 Notification of Violation
- R6.3.2 Consideration of Factors
- R6.3.3 Letter of Reprimand
- R6.3.4 Suspension, Revocation, Administrative Penalties
  - R6.3.4.1 Hearing procedure
- R6.3.5 Injunction, Restitution
- R6.3.6 Fines and Criminal Penalties

780 CMR R6.4 Enforcement Actions

- R6.4.1 Administrative Penalties
  - R6.4.1.1 Allowable actions
  - R6.4.1.2 Pendency of claims
- R6.4.2 Fines and Criminal Penalties
  - R6.4.2.1 Sought by attorney general or district attorney
  - R6.4.2.2 Operating without certificate
  - R6.4.2.3 Other violations
- R6.4.3 Injunction, Restitution
  - R6.4.3.1 Order from superior court
  - R6.4.3.2 Director bond not required
- R6.4.4 Permit Requirements, Prohibited Acts and Penalties
  - R6.4.4.1 Permit requirements
  - R6.4.4.2 Prohibited acts
  - R6.4.4.3 Penalties
  - R6.4.4.4 Deceptive act

780 CMR R6.5 Contracts

- R6.5.1 Contract in Writing
- R6.5.2 Contents of Contract
  - R6.5.2.1 Documents and information
  - R6.5.2.2 Permit notice
  - R6.5.2.3 Acceleration of payment
  - R6.5.2.4 Copy to owner
  - R6.5.2.5 Alternative dispute resolution
- R6.5.3 Dispute Resolution
  - R6.5.3.1 Court action
  - R6.5.3.2 Owner right to arbitration
  - R6.5.3.3 Contractor right to arbitration
- R6.5.4 Validity of contract

780 CMR R6.6 Supplementary Identification Cards

- R6.6.1 Definitions
- R.6.6.2 Certificates of registrants
  - R.6.6.2.2 Non-Individual Registrants
- R6.6.3 Fees
- R6.6.4 Expiration

780 CMR R6.1 GENERAL PROVISIONS

R6.1.1 Title: 780 CMR R6 is authorized and promulgated by the administrator of the State Board of Building Regulations and Standards under the authority of M.G.L. c. 142A.

R6.1.2 Definitions:

Application: The form provided by the director which, along with other documentation and fee(s) that may be required, must be duly filed to become a registered home improvement contractor or subcontractor.

Advertisement: Any commercial message in any newspaper, magazine, leaflet, flyer, catalog, display space in the telephone book, on radio, television, public address system, or made in person, by letter or other printed material, or any interior or exterior sign or display, including on a vehicle, which is delivered or made available to an owner by a registrant in any manner whatsoever.

Applicant: Any person who files an application to become registered as a home improvement contractor or subcontractor.

BBRS: The State Board of Building Regulations and Standards

Certificate: The document provided to the registrant which lists the certificate number and other information required by the director.

Certificate number: See registration number.

Clear and Conspicuous: The material representation being disclosed is of ten point type and is so presented as to be readily noticed and understood by a reasonable person. Language in the body of a contract is "conspicuous" if it is in larger or contrasting type or color, or underscored.

Contract: Unless specifically noted otherwise in the text, a written agreement between a home improvement contractor and an owner contained in one or more documents for the performance of certain residential contracting work, including all labor, material, goods and services set forth under said agreement for a total amount exceeding $1,000.00.

Contractor: Any person who, through himself or others, undertakes, offers to undertake, purports to have the capacity to undertake, or submits a bid for construction work. (See "home improvement contractor")

Director: The administrator of the State Board of Building Regulations and Standards, an agency within the executive office of public safety, established by M.G.L. c. 6A, § 19.

Employee: For the purposes of 780 CMR R6 in determining the number of employees of an applicant for registration, any individual engaged in construction related activities who, in the weekly pay period prior to the date of registration worked 20 or more hours for the registrant and for whom, the registrant withheld or was required to withhold federal or state income taxes and who, during the same pay period, was not otherwise paid or had such taxes withheld by any other registrant. Included would be all construction workers, supervisors, sales personnel, designers, estimators, active partners and officers of corporations.

Fund: The residential contractor's guaranty fund. See "guaranty fund".

Fund administrator: the administrator of the residential contractor's guaranty fund, appointed by the secretary of the Office of Consumer Affairs and Business Regulation.

Guaranty fund: The residential contractor's guaranty fund. A fund out of which an owner, as defined herein, aggrieved by a registrant(s) may be paid part or all of their damages under rules and regulations promulgated by the secretary of the Office of Consumer Affairs and Business Regulation.

Home improvement contractor: Any person who owns or operates a contracting business who, through himself or others, undertakes, purports to have the capacity to undertake, offers to undertake, or submits a bid for residential contracting work to an owner, as such work is defined in 780 CMR R6 and M.G.L. c. 142A, and such work for each project is in a total amount in excess of $1,000, and is registered or required to be registered in accordance with M.G.L. c. 142A and 780 CMR R6.

Homeowner: See "owner".

Local consumer group: A local or regional agency which deals with the resolution of consumer problems and who is determined eligible by the attorney general under standards set by the attorney general in accordance with M.G.L. c. 12, § 11G.

Mortgage broker: Any person, who, for compensation or gain, or in the expectation of compensation or gain, directly or indirectly negotiates, places, assists in placement, finds or offers to negotiate, place, assist in placement of mortgage loans on residential property for others, or as otherwise defined in M.G.L. c. 255E.

Mortgage lender: Any person engaged in the business of making mortgage loans, or issuing commitments to fund mortgage loans, or accepting applications or fees associated with the making of mortgage loans which are secured by a mortgage on residential property, or as otherwise defined in M.G.L. c. 255E.

Mortgage loan: A loan to any person made primarily for personal, family, or household purposes, secured wholly or partially by a mortgage on a residential property, or as otherwise defined by M.G.L c. 255E.

Owner: Any homeowner of a building which is an existing building at the time of a contract that is owner occupied, containing at least one but not more than four dwelling units, or a tenant authorized by the homeowner thereof, who orders, contracts for, or purchases the services of a contractor or subcontractor. An owner occupying a condominium unit in a building containing no more than four dwelling units qualifies as an owner under this definition, provided the owner owns a total of not more than four condominium units. A condominium association does not qualify as an owner.

Owner-occupied: The residential building of at least one but not more than four dwelling units and occupied by the owner as a primary residence.

Permit: For the purposes of 780 CMR R6, any construction-related permit, excluding any permits required by the owner which are not considered construction-related, such as zoning, environmental, historical commission, and the like.

Person: Any individual, partnership, corporation, society, trust, association, or any other legal entity.

Registrant: Any duly registered home improvement contractor or subcontractor.

Registration number: The number assigned to the applicant after he has been approved for registration by the director and the Board of Building Regulations and Standards.

Residential contracting: The reconstruction, alteration, renovation, repair, modernization, conversion, improvement, removal or demolition or the construction of an addition to any pre-existing owner-occupied building containing at least one but not more than four dwelling units, which building or portion thereof is used or designed to be used as a residence or dwelling unit, or to structures which are adjacent and accessory to such residence or building, including but not necessarily limited to: garages, sheds, cabanas, poolhouses, gazebos.

Salesperson: any person, other than a supplier of materials or a laborer, who solicits, offers, negotiates, executes, or otherwise endeavors to procure by any means whatsoever, directly or indirectly, a contract for residential contracting services from an owner on behalf of a home improvement contractor or subcontractor.

Secretary: The secretary of the Office of Consumer Affairs and Business Regulations.

Subcontract: A contract, written or verbal, in any amount, between a home improvement contractor and a subcontractor or between two subcontractors for the performance of any part of the home improvement contractor's or subcontractor's contract.

Subcontractor: Any person, other than a supplier of only materials, who enters into a contract, written or verbal, with a home improvement contractor for the performance of any part of a home improvement contractor's contract with an owner for residential contracting, or who enters into a contract with any other subcontractor for the performance of any part of the subcontractor's contract.

R6.1.3 Scope:

R6.1.3.1 M.G.L. c. 142A and 780 CMR R6 require the registration of persons who engage in residential contracting work as defined in 780 CMR R6 and M.G.L. c. 142A after July 1, 1992, and define the requirements of M.G.L. c. 142A and enforcement of these requirements, as they pertain to home improvement contractors and subcontractors.

R6.1.3.2 Except for those persons who are specifically exempt from the provisions of 780 CMR R6 and M.G.L. c. 142A, all contractors and subcontractors who engage in residential contracting as defined in 780 CMR R6 and M.G.L. c. 142A shall be subject to and shall comply with 780 CMR R6 and M.G.L. c. 142A.

R6.1.4 Administration and Enforcement:

R6.1.4.1 Director responsibility: The director shall promulgate and enforce the provisions of 780 CMR R6 and M.G.L. c. 142A as to all home improvement contractors and subcontractors who are registered or required to register.

R6.1.4.2 Advisory board: The director may appoint an advisory board which may review proposed suspensions, revocations, and administrative penalties against any registrants, and shall make recommendations to the director relative thereto. The advisory board shall include six members, any four of whom will constitute a quorum; the fund administrator, a representative of the attorney general, a representative of a consumer group appointed by the secretary, a representative of the Massachusetts Homebuilders Association who is a registered home improvement contractor or subcontractor, a Representative of the National Association of the Remodeling Industry, and a BBRS staff member.

R6.1.5 Persons Who Must Register:

R6.1.5.1 General: All home improvement contractors and subcontractors, as defined in 780 CMR R6, except those exempt in 780 CMR R6.1.6, shall register with the director by filing an application prescribed by the director.

R6.1.5.2 Designated individual: In the case of registration by a corporation or partnership, an individual shall be designated to be responsible for the corporation's or partnership's residential contracting work.

R6.1.5.3 Liability: The corporation or partnership and its designee shall be jointly and severally liable for the payment of the registration fee, the payment to the guaranty fund, and for violations of any provisions of 780 CMR R6, including actions by the registrant's employees, subcontractors or salespersons.

R6.1.6 Persons Exempt From Registration or Renewal: Any person exempt from registration under 780 CMR R6.1.6, and does not voluntarily register, is not subject to any of the provisions of 780 CMR R6 or M.G.L. c. 142A. Persons exempt from registration are:

1. the Commonwealth or its political subdivisions;
2. any school, public or private, offering as part of a vocational education program courses and training in any aspects of home construction or home improvements;
3. electricians, plumbers, architects or any other persons who are required by law to attain standards of competency or experience as a prerequisite to licensure for and engaging in such trade or profession and who are acting exclusively within the scope of the profession for which they are currently licensed pursuant to such law, *construction supervisors excepted.*
4. persons dealing in the sale of goods or materials who neither arrange to perform nor perform directly or indirectly any work or labor in connection with the installation of or application of the goods or materials;
5. any owner personally doing residential contracting work on his/her own home;
6. any individual who performs construction related labor or services for a home improvement contractor or subcontractor, for wages or salary and who does not act in the capacity of a home improvement contractor or subcontractor;
7. any contractor or subcontractor who works on one residential contracting undertaking or project by one or more contracts where the aggregate contract price to the owner is less than **$500**; provided, however, that the contract is not in an amount of less than **$500** for the purpose of evading 780 CMR R6 or M.G.L. c. 142A.
8. any person who engages in the business of a home improvement contractor or subcontractor on other than a full-time basis, and who has earned in gross revenues from residential contracting work, less than $5,000 in the previous 12-month period;
9. any person acting as a home improvement contractor or subcontractor who was enrolled as a full-time student in a secondary school or college with degree granting authority from the government of the state in which the school is located, for the immediately preceding academic semester and is also enrolled as a full-time student for the next academic semester, in the same or a similar degree granting secondary school or college provided that at least ⅔ of the number of employees of the contractor or subcontractor are similarly enrolled in secondary schools or colleges and that the home improvement contractor or subcontractor does not reasonably expect to earn or does not in fact earn, in gross revenues, more than $5,000 from residential contracting work;
10. persons who install any or all of the following:
    - central heating,
    - air-conditioning systems,
    - energy-conservation devices, or
    - provides conservation services conducted by or on behalf of a public utility under a program approved by the department of public utilities;
11. any contractor or subcontractor who works exclusively in any of the following home improvement areas:
    - landscaping;
    - interior painting or wall covering;
    - finished floor covering, including, but not limited to, carpeting, vinyl, tile, non-structural hardwood;
    - fencing or freestanding masonry walls;
    - above-ground swimming pools;

- shutter or awning installation;
- ground level patios; includes flagstone, concrete, block, and wood set directly onto the ground; excludes decks which are supported above ground.
- asphalt and driveway installation and maintenance.

780 CMR R6.2 REGISTRATION PROCEDURE

R6.2.1 Applicant Actions:

R6.2.1.1 Application: Each applicant for registration as a home improvement contractor or subcontractor shall submit a completed copy of an application form supplied by the director and necessary supporting documents to the director, along with such fees as required by the provisions of 780 CMR R6.2.4, and M.G.L. c. 142A.

R6.2.1.2 Supporting documentation: Supporting documentation shall include, as applicable:

1. **For corporations**: an official document which lists the names and addresses of officers, directors, and major stockholders such as: a copy of the articles of incorporation, a current annual report as filed with the Secretary of State, a copy of the registration as a foreign corporation filed with the Secretary of State, or any other documentation which lists the names and addresses of officers, directors, and major stockholders, will be accepted in lieu of listing these names on the application.
2. **For partnerships**: either a copy of the current partnership agreement containing the requested information, or listing of the names and addresses of all partners on the application form.
3. **For all non-corporate applicants**: a copy of the business registration certificate filed with a city or town pursuant to M.G.L. c. 110, § 5, if applicable.

R6.2.1.3 Mailing address: The application, supporting documentation and fees may be mailed or delivered as follows:

Director
Home Improvement Contractor Registration
One Ashburton Place, Room 1301
Boston, MA 02108

It shall be the responsibility of the applicant to assure that the required registration material is received by the director.

R6.2.1.4 Certified check/money order: All applications shall be accompanied by the registration fee or by evidence of exemption, and by the fee for the guaranty fund. Fees shall be in the form of a money order or certified check. Two money orders or certified checks shall be included - one for the registration fee, if required, and one for the guaranty fund. Make checks or money orders payable to the Commonwealth of Massachusetts.

As noted in 780 CMR R6.2.4.1.2, licensed individual construction supervisors and individual motor vehicle repair shops who desire to register are exempt from the registration fee only; there are no exemptions to the requirement for a contribution to the guaranty fund.

R6.2.1.5 Lost/destroyed certificate of registration: Upon receipt of a nominal fee as established by the Commonwealth, and a completed affidavit provided by the director, that a certificate of registration has been lost or destroyed, a replacement certificate clearly identified as such, shall be issued by the director.

R6.2.1.6 Licensee liabilities: The provisions of 780 CMR R6 and those of M.G.L. c. 142A shall not be construed to relieve or lessen the responsibility of any person registered under 780 CMR R6 and M.G.L. c. 142A or licensed under M.G.L. c. 143, § 94(i), nor shall the Commonwealth be deemed to have assumed any such liability by reason of the issuance of registration or licensure.

R6.2.2 Director's Action on Application:

R6.2.2.1 Issuance of certificate: Upon receipt of a completed application form, supporting documentation, and the proper fee(s) therefor, the director shall:

- ascertain whether such applicant meets all of the registration requirements and there are no grounds for rejection as specified in 780 CMR R6.2.2.2;
- if all requirements are met, the Director, within 30 days of receipt of the application shall assign a registration number, with the approval of the BBRS;
- prepare and send by first class mail to such applicant, at the address stated on the registration form, a certificate indicating the applicant's registration number, name, address, name of the entity of the applicant, and such other information as is deemed necessary by the director. *The registration certificate is not transferable to any other person.*

R6.2.2.2 Grounds for refusal to register or renew: No application for registration or renewal conforming to 780 CMR R6 and M.G.L. c. 142A may be denied except for a finding by the director that the applicant has done one or more of the following acts which are grounds for denial after the effective date of 780 CMR R6:

1. made material omissions or misrepresentations of fact on the home

improvement contractor or subcontractor application for registration or renewal and supporting documentation or on an application for licensure or renewal under M.G.L. c. 143, § 94(i). (construction supervisor license);
2. failed to pay either the registration fee or the payment to the fund as required under 780 CMR R6.2.4.
3. failed consistently to perform contracts or has performed said contracts in an unworkmanlike manner or has failed to complete said contracts with no good cause or has engaged in fraud or bad faith with respect to said contracts;
4. failed to meet or has violated any of the requirements for registered home improvement contractors or subcontractors as defined in 780 CMR R6, or has performed or is attempting to perform any act prohibited by 780 CMR R6 and M.G.L. c. 142A.
5. is under suspension or revocation of registration as a home improvement contractor or subcontractor;
6. has failed to repay the guaranty fund for any payments made by the fund on the registrant's account.

R6.2.2.3 Application refused: If the application is refused, the director shall, within thirty days of the application, notify the applicant in writing by first class mail of the reasons for the rejection.

R6.2.2.3.1: If applicable, the applicant may correct the deficiencies in the application material and return the corrected data to the director within ten days of the date of mailing of the director's notice of refusal, who will then assign a registration number and issue a certificate.

R6.2.2.3.2: If the grounds for rejection are based upon substantive grounds for refusal of 780 CMR R6.2.2.2, and M.G.L. 142A, the applicant may request that the director reconsider the application as submitted by stating his/her reasons therefore, in writing, within ten days of the date of mailing of the notice of the director's rejection of the application.

R6.2.2.4 Record retention: The director shall keep a record of the date the application and all pertinent documents are received. In addition, the director shall keep on file, in convenient form and open to public inspection, all applications for registration, copies of certificates issued, and the names of all home improvement contractors or subcontractors whose registration has been revoked, suspended or surrendered.

R6.2.3 Duration of Registration:

R6.2.3.1 Initial registration: Each such registration shall be in effect for two years from the date of issuance, unless suspended or revoked prior to that time, as provided in 780 CMR R6 and M.G.L. c. 142A.

R6.2.3.2 Renewal of registration: Not less than 90 days before the date of the expiration of such registration, the director shall send or cause to be sent, to each registered contractor or subcontractor, at the address on record, a notice for renewal of the registration and a copy of all forms necessary for such renewal, by first class mail, along with a schedule of such fees as are necessary for said renewal. Renewals will remain in effect for two years from date of renewal if not suspended or revoked prior to that time. The responsibility for timely renewal of registration remains with the registrant, notwithstanding this notice. An applicant shall submit a renewal application with fees within one year of the expiration date of the registration. Failure to submit a renewal application within this time period shall subject the applicant to a fee equal to the amount for initial registration.

R6.2.4 Fees to be Paid Upon Registration or Renewal:

R6.2.4.1 Registration and renewal fee: All home improvement contractors and subcontractors, except those that are exempt from the registration or renewal fee in 780 CMR R6.2.4.1.2, shall, at the time of registration or renewal, pay to the Commonwealth, a fee in the amount of the fee then being charged for the construction supervisor's license under M.G.L. c. 143, § 94(i).

R6.2.4.1.2 Exemptions from registration and renewal fee:
1. Every individual construction supervisor licensed by the BBRS in accordance with M.G.L. c. 143, § 94(i), and every individual motor vehicle repair shop registered in accordance with M.G.L. c. 100A, § 2, who desires to be registered or renew their registration as a home improvement contractor or subcontractor, and whose license or registration fee has been paid and is current, shall be deemed to have paid the registration fee required by 780 CMR R6.2.4.1.
2. If the applicant is a corporation or partnership and the named individual responsible for home improvement contracting work is a licensed construction supervisor and a substantial owner (10% or more of ownership), the applicant entity is exempt from the registration and renewal fee.

R6.2.4.2 Contribution to guaranty fund - initial registration: At the time of initial registration, contractors and subcontractors shall also pay to the Commonwealth, in a separate certified check or money order from the above stated registration fee, if any, a fee payable to the guaranty fund.

R6.2.4.2.1 The fee paid by contractors and subcontractors to the guaranty fund shall be determined based on the number of employees (active construction-related personnel) of the home improvement contractor or subcontractor, as defined in 780 CMR R6.1.2, on the date of initial registration, as follows:

1. Zero to 3 employees	$100.00
2. 4 employees up to and including 10	$200.00
3. 11 employees up to and including 30	$300.00
4. More than 30 employees	$500.00

R6.2.4.2.2: *The fee to the guaranty fund shall be paid by every registered home improvement contractor and subcontractor regardless of whether such registrant is exempt from paying the registration fee because of the home improvement contractor or subcontractor's status as a licensed construction supervisor or registered motor vehicle repair shop owner.*

R6.2.4.2.3: Any registrant who fails to accurately determine the number of employees and pay the correct fee therefor shall be deemed to have failed to pay the fees required for registration and shall be subject to enforcement action by the director, in accordance with 780 CMR R6.2.2.2, 4.1 and 4.3.

R6.2.4.2.4: No home improvement contractor or subcontractor shall be required to pay the contribution to the guaranty fund more than once unless the fund administrator determines that the amount of the fund is insufficient to maintain it at a level commensurate with claims made against the fund. If such a determination is so made, after conducting a public hearing, the director, in consultation with the fund administrator, may assess each registered home improvement contractor or subcontractor an appropriate fee, the amount to be determined by the commissioner of administration and finance, which shall not exceed the amount of the original assessment; provided, however, that the director shall not assess any registrant more than once in any 12 month period.

R6.2.5 Responsibilities of Each Registrant:

R6.2.5.1 Changes in status: Each registrant shall be responsible for reporting, in writing, within thirty days, changes in trade name or address or additions of business name(s), and any other pertinent changes in circumstances to the director.

R6.2.5.2 Display of certificate number: Every contract, building permit and advertisement for residential contracting as defined in 780 CMR R6 shall display the home improvement contractor's or subcontractor's certificate of registration number.

R6.2.5.3 Return of certificate: Upon the expiration, termination or voluntary surrender of a registration, the registrant shall deliver the certificate to the director who shall cancel the registration and endorse the date of expiration, termination or surrender. In such case, no further residential contracting work will be engaged in by the contractor or subcontractor.

780 CMR R6.3 ENFORCEMENT PROCEDURES

R6.3.1 Notification of Violation: The fund administrator shall notify the director if a registrant fails to repay the fund for any payment made from the fund to an owner because of the conduct of said registrant. In addition, the secretary, attorney general, district attorney, or local consumer groups as defined in 780 CMR R6.1.2, shall advise the director of orders resulting from arbitration or court action, or other significant complaint activity against individual registrants, accompanied by a recommendation for enforcement action against a registrant. Significant complaint activity shall include but not necessarily be limited to:

1. repeated acts prohibited under 780 CMR R6.4.4;
2. a flagrant complaint or complaints involving substantial harm to an owner or owners.

Nothing in 780 CMR R6.3.1 shall preclude the director from initiating enforcement action on his own initiative.

R6.3.1.1 Determination that a Home Improvement Contractor complaint may involve Construction Supervisor Licensing: If, upon review of a Home Improvement Contractor complaint the Board or the Hearings Officer determines that such complaint may involve possible Construction Supervisor License violations per 780 CMR R5, such Construction Supervisor License complaint hearing may be conducted simultaneously with the Home Improvement Contractor complaint hearing.

Where possible violations of 780 CMR R5 exist, the notification and hearing shall also conform to the requirements of 780 CMR R5 as applicable.

R6.3.2 Consideration of Factors: The director, upon receipt of the notification under 780 CMR R6.3.1 shall consider the pertinent factors in the particular situation, and decide what enforcement action in accordance with 780 CMR R6.4, if any, shall be taken against the registrant considering, among any other pertinent factors, the recommendations of the secretary, attorney general, district attorney, and/or the local consumer group(s), the severity of the violation(s), the frequency of repetitive violations, the harm to the complainant or the general public, and the impact upon the registrant.

R6.3.3 Letter of Reprimand: The director, on his own initiative, may send a letter of reprimand to the registrant containing the facts of the situation, which may include that the incident has been noted on the registrant's official records, and the possibility of more severe disciplinary action in the event of repetitive violations.

R6.3.4 Suspension, Revocation, Administrative Penalty: The director may institute a suspension or revocation of registrant's certificate of registration, or administrative penalty against a registrant, subject to the following hearing provisions:

R6.3.4.1 Hearing procedure:

R6.3.4.1.1 Notice of hearing:

1. The director shall give at least 14 days notice of a scheduled hearing to the registrant, and all parties to the hearing *i.e.*, the secretary, the attorney general, the district attorney, and/or the local consumer group from whom the recommendation for enforcement action was received. Notice to the registrant will be deemed sufficient if it is mailed to the most recent address of record in the director's file.
2. The notice of hearing shall contain, at minimum:
    a. The nature of the violation;
    b. A statement of the enforcement action recommendation;
    c. The date, time and place for the hearing;
    d. Notice that the registrant may be represented by legal counsel;
    e. Advise that the complete investigation file is available for review at the office of the director during regular business hours;
    f. Notice that the registrant may present written and oral testimony and evidence to mitigate any planned enforcement action.
3. The hearing will be conducted by the director or a hearings officer appointed by the director.

R6.3.4.1.2 Rescheduling of hearing: The director, at his discretion, may delay and reschedule the date for such hearing upon written request of the registrant, the secretary, the attorney general, a district attorney, or the involved local consumer group, provided the request is received not less than seven days prior to such hearing.

R6.3.4.1.3 Decision: Following the close of the hearing, the director shall issue a written decision on the violation within 30 working days. A copy of the decision shall be sent to the registrant, the secretary, the attorney general, the involved district attorney and local consumer group.

R6.3.4.1.3.1 Decisions also involving Construction Supervisor License responsibilities: If the Decision involves consideration of Construction Supervisor License matters per 780 CMR R5 then such Decision shall also comply with the requirements of 780 CMR R5 as applicable.

R6.3.4.1.4 Appeal: Any party to the hearing who is aggrieved by the decision may appeal under the applicable provisions of the Massachusetts Administrative Procedures Act, M.G.L. c. 30A.

R6.3.5. Injunctions, Restitution: The director, on his own initiative, may institute court action in accordance with 780 CMR R6.4.3, to obtain a permanent or temporary injunction or an order requiring restitution or completion of a home improvement contractor's contract with an owner.

R6.3.6 Fines and Criminal Penalties: The attorney general or a district attorney may initiate court action on his own initiative in accordance with 780 CMR R6.4.2.

780 CMR R6.4 ENFORCEMENT ACTIONS

R6.4.1 Administrative Penalties: If the director determines that any registrant is liable for a violation of any of the provisions of 780 CMR R6 or M.G.L. c. 142A, the director may institute one or more of the following actions:

R6.4.1.1 Allowable actions:

1. suspend the registrant's certificate of registration for such period of time as shall be determined by the director;
2. revoke the registrant's certificate of registration;
3. send a letter of reprimand to the registrant;
4. assess an administrative penalty not to exceed $2,000, payable within 30 days of the date of the order of assessment, for each violation of any provisions of 780 CMR R6 and M.G.L. c. 142A committed by the home improvement contractor(s) or subcontractor(s) who are registered or required to be registered under 780 CMR R6. This penalty shall be deposited to the fund.

R6.4.1.2 Pendency of a claim: The pendency of a claim against the fund shall not limit the director from taking enforcement action against any registrant pursuant to 780 CMR R6 or M.G.L c. 142A.

R6.4.2 Fines and Criminal Penalties:

R6.4.2.1 Sought by attorney general or district attorney: Fines and imprisonment specified in 780 CMR R6 and M.G.L. c. 142A may be sought by the attorney general or a district attorney, and such fines and imprisonment shall be in addition to any administrative penalty otherwise applicable thereto.

R6.4.2.2 Operating without a certificate: Any home improvement contractor or subcontractor who shall knowingly, willfully, or negligently operate without obtaining a certificate of registration as required by 780 CMR R6 and M.G.L. c. 142A and who is not otherwise exempt from the registration requirements or any home improvement contractor or subcontractor who continues to operate after revocation of or during suspension of, or who had failed to renew his

NON-TEXT PAGE

certificate of registration, shall be punished by a fine not exceeding $5,000 or imprisonment not exceeding two years or both.

R6.4.2.3 Other violations: Any person who knowingly and willfully violates any of the provisions of 780 CMR R6 or M.G.L. c. 142A, with respect to which a greater penalty is not otherwise provided by the provisions of 780 CMR R6 or M.G.L. c. 142A or by any other law may be punished by a fine of not more than $2,000 or by imprisonment for not more than one year or both.

R6.4.3 Injunctions, Restitution:

R6.4.3.1 Order from superior court: If the director concludes that the continuing conduct of any person alleged to be in violation of 780 CMR R6 and M.G.L. c. 142A may result in substantial or irreparable harm to any citizen of the Commonwealth, the director may seek:

1. a permanent or temporary injunction with respect to the conduct from the superior court of any county in which the alleged violation is occurring, or in which the violator has its principal place of business; or
2. an order requiring restitution or satisfactory completion of the home improvement contractor's contract with an owner.

R6.4.3.2 Bond not required: The director shall not be required to file a bond or to show a lack of an adequate remedy at law when seeking an injunction under M.G.L. c. 142A against any person, association, partnership, or corporation not registered under 780 CMR R6 and M.G.L. c. 142A.

R6.4.4 Permit Requirements, Prohibited Acts and Penalties:

R6.4.4.1 Permit requirements: All building permits for residential contracting work covered by 780 CMR R6 and M.G.L. c. 142A shall:

1. clearly state that persons contracting with unregistered contractors do not have access to the guaranty fund;
2. contain the registered home improvement contractor's or subcontractor's certificate number.

R6.4.4.2 Prohibited acts: The following acts are prohibited by registered home improvement contractors or subcontractors, and those required to register under the provisions of 780 CMR R6 and M.G.L. c. 142A:

1. operating without a certificate of registration issued by the director;
2. abandoning or failing to perform, without justification, any contract or project engaged in or undertaken, or deviating from or disregarding plans or specifications in any material way without the consent of the owner, except for changes in plans, specifications, or construction techniques required by building regulations;
3. failing to credit the owner any payment they have made to the contractor or his salesperson in connection with a residential contracting transaction;
4. making any material misrepresentation in the procurement of a contract or making any false promise of a character likely to influence, persuade or induce the procurement of contract;
5. acting directly, regardless of the receipt or expectation of receipt of compensation or gain from the mortgage lender, in connection with a residential contracting transaction by preparing, offering or negotiating or attempting to or agreeing to prepare, arrange, offer or negotiate a mortgage loan on behalf of a mortgage lender;
6. acting as a mortgage broker or agent for any mortgage lender;
7. publishing, directly or indirectly, any advertisement relating to residential contracting which does not contain the home improvement contractor's or subcontractor's certificate of registration number or which does contain an assertion, representation or statement of fact which is false, deceptive, or misleading;
8. advertising in any manner that a registrant is registered under 780 CMR R6 unless the advertisement includes an accurate reference to the home improvement contractor's or subcontractor's certificate of registration;
9. violating any of the building laws of the Commonwealth or of any political subdivision thereof;
10. misrepresenting a material fact by an applicant in obtaining a certificate of registration;
11. failing to notify the director of any change of trade name or address as required by 780 CMR R6.2.5.1;
12. conducting a residential contracting business in any name other than the one in which the home improvement contractor or subcontractor is registered;
13. failing to pay for materials or services rendered in connection with his/her operating as a home improvement contractor or subcontractor where he/she has received sufficient funds as payment for the particular construction work, project or operation for which the services or materials were rendered or purchased;
14. failing to comply with any order, demand or requirement lawfully made by the director or fund administrator under and within the authority of 780 CMR R6 and M.G.L. c. 142A;

15. demanding or receiving payment in violation of 780 CMR R6.5.2. item 5, 6, or 5.2.2;

16. violating any other provisions of 780 CMR R6 and M.G.L. c. 142A.

17. failing to pay to the guaranty fund in full, including interest, any amount paid from said fund because of the conduct of the registrant.

18. any of the grounds for refusal to register or renew in 780 CMR R6.2.2.2 are also considered prohibited acts.

19. failing, within 21 days, to comply with, or advise the owner of intent to comply with, or appeal the decision of, an arbitrator as provided for in M.G.L. c. 142A and 201 CMR 14:00.

20. failing to display the registration number on every contract, building permit and advertisement as required by 780 CMR R6.5.2.1 item 2, R6.4.4.1 item 2, R6.4.4.2 item 7, and R6.4.4.2 item 8.

R6.4.4.3 Penalties: Violations of 780 CMR R6 or M.G.L. c. 142A shall subject the violator to the administrative sanctions of 780 CMR R6.4.1 and to criminal prosecution or other court action as prescribed in 780 CMR R6.4.2 and 4.3.

R6.4.4.4 Deceptive act: Violations of any of the provisions of 780 CMR R6 and M.G.L. c. 142A shall constitute an unfair or deceptive act under the provisions of M.G.L. c. 93A.

780 CMR R6.5 CONTRACTS

R6.5.1 Contract in Writing: Every agreement between a home improvement contractor and an owner to perform residential contracting services in an amount in excess of $1,000 shall be in writing.

R6.5.2 Contents of Contract:

R6.5.2.1 Documents and information: Every agreement to perform residential contracting services in excess of $1,000 shall include, but not be limited to, the following documents and information:

1. the complete agreement between the owner and the contractor and a clear description of any other documents which are or shall be incorporated into said agreement;

2. the full names, federal ID number if applicable, (exclusive of social security number), address (exclusive of post office box addresses), registration number of the home improvement contractor, the name(s) of the salesperson(s), if any, who solicited or negotiated the contract and the date when said contract was executed by the parties;

3. the date on which the work under the contract is scheduled to begin and the date on which said work is scheduled to be substantially completed;

4. a detailed description of the work to be done and the materials to be used;

5. the total amount agreed to be paid for the work to be performed under the contract;

6. a time schedule of payments to be made under said contract and the amount of each payment stated in dollars, including all finance charges, if any. Any deposit required under the contract to be paid in advance of the commencement of work under said contract shall not exceed the greater of ⅓ of the total contract price or the actual cost of any material or equipment of a special order or custom made nature, which must be ordered in advance of the commencement of the work, in order to assure that the project will proceed on schedule. No final payment shall be demanded until the contract is completed to the satisfaction of the parties thereto;

7. the signature of all parties shall be affixed to the contract;

8. there shall be a clear and conspicuous notice appearing in the contract stating:

a. that all home improvement contractors and subcontractors shall be registered by the director and that any inquiries about a contractor or subcontractor relating to a registration should be directed to:

Director
Home Improvement Contractor Registration
One Ashburton Place, Room 1301
Boston, MA 02108
(617) 727-8598

b. the registration number of the home improvement contractor on the first page of the contract.

c. the owner's three-day cancellation rights under M.G.L. c. 93, § 48; M.G.L. c. 140D, § 10 or M.G.L. c. 255D, § 14, as may be applicable.

d. all warranties and the owner's rights under the provisions of 780 CMR R6 and M.G.L. c. 142A;

e. in ten point bold type or larger, directly above the space provided for the signature, the following statement:

DO NOT SIGN THIS CONTRACT IF THERE ARE ANY BLANK SPACES

f. whether any lien or security interest is on the residence as a consequence of the contract;

(9) an enumeration of such other matters upon which the owner and the contractor may lawfully agree; provided, however that no such agreement may waive any rights conveyed to the owner under the provisions of 780 CMR R6 and M.G.L. c. 142A;

(10) any other provision otherwise required by the applicable laws of the Commonwealth.

#327

THE COMMONWEALTH OF MASSACHUSETTS

William Francis Galvin
Secretary of the Commonwealth

Notice of Compliance

Regulation Filing *To be completed by filing agency*

CHAPTER NUMBER: 780 CMR R7

CHAPTER TITLE: Certification of Inspectors of Buildings, Building Commissioners and Local Inspectors

AGENCY: Department of Public Safety / Board of Building Regulations and Standards

THIS REGULATION WAS ORIGINALLY ADOPTED AS AN EMERGENCY:

Published in Massachusetts Register Number: #1034 *Date:* 9/9/04

PRIOR NOTIFICATION AND/OR APPROVAL - *If prior notification to and/or approval of the Governor, Legislature or others was required, list each notification, and/or approval and date, including notice to the Local Government Advisory Commission.*

Local Government Notice on 4/21/04 and 10/18/04, respectively

PUBLIC REVIEW- *M.G.L. c. 30A, §§ 2 and/or 3 requires notice of the hearing or comment period to be filed with the Secretary of the Commonwealth, published in appropriate newspapers, and sent to persons whom specific notice must be given at least 21 days prior to such hearing or comment period.*

Date of public hearing or comment period: Comment Period thru 6/11/04 and 12/9/04 respectively

Publication - *To be completed by the Regulations Division*

MASSACHUSETTS REGISTER NUMBER: #1034 DATE: 9/9/05

EFFECTIVE DATE: 8/26/05

CODE OF MASSACHUSETTS REGULATIONS

Remove these pages:	*Insert these pages:*
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A TRUE COPY ATTEST

WILLIAM FRANCIS GALVIN
SECRETARY OF THE COMMONWEALTH

DATE 8/26/05 CLERK

R6.5.2.2 Permit notice: Any contract entered into between a home improvement contractor and an owner shall contain a clause informing the owner of the following:

1. any and all necessary construction-related permits;
2. that it shall be the obligation of the home improvement contractor to obtain such permits as the owner's agent;
3. that owners who secure their own construction-related permits or deal with unregistered contractors will be excluded from the guaranty fund provisions of M.G.L. c. 142A;

R6.5.2.3 Acceleration of payment: No contract shall contain an acceleration clause under which any part or all of the balance not yet due may be declared due and payable because the holder deems himself to be insecure. However, where the contractor deems himself to be insecure he/she may require as a prerequisite to continuing said work that the balance of funds due under the contract, which are in the possession of the owner, shall be placed in a joint escrow account requiring the signatures of the home improvement contractor and owner for withdrawal.

R6.5.2.4 Copy to owner: At the time of signing, the owner shall be furnished with a copy of the contract signed by both the home improvement contractor and the owner. No work shall begin prior to the signing of the contract and transmittal to the owner of a copy of such contract.

R6.5.2.5 Arbitration: Any contract entered into between a home improvement contractor and owner may provide that the home improvement contractor may initiate alternative dispute resolution through any private arbitration services approved by the secretary, as provided in M.G.L. c. 142A; provided, that said alternative dispute resolution provision is clearly and conspicuously disclosed in the contract, in language designated by the secretary, and that each party separately signs and dates the provision, thereby assenting to the procedure. The following language and format is acceptable:

THE CONTRACTOR AND THE HOMEOWNER HEREBY MUTUALLY AGREE IN ADVANCE THAT IN THE EVENT THE CONTRACTOR HAS A DISPUTE CONCERNING THIS CONTRACT, THE CONTRACTOR MAY SUBMIT SUCH DISPUTE TO A PRIVATE ARBITRATION SERVICE WHICH HAS BEEN APPROVED BY THE SECRETARY OF THE EXECUTIVE OFFICE OF CONSUMER AFFAIRS AND BUSINESS REGULATIONS AND THE CONSUMER SHALL BE REQUIRED TO SUBMIT TO SUCH ARBITRATION AS PROVIDED IN M.G.L. c.142A.

____
Contractor

____
Owner

NOTICE: THE SIGNATURES OF THE PARTIES ABOVE APPLY ONLY TO THE AGREEMENT OF THE PARTIES TO ALTERNATIVE DISPUTE SETTLEMENT INITIATED BY THE CONTRACTOR. THE OWNER MAY INITIATE ALTERNATIVE DISPUTE RESOLUTION EVEN WHERE THIS SECTION IS NOT SEPARATELY SIGNED BY THE PARTIES.

R6.5.3 Dispute Resolution

R6.5.3.1 Court action: Any party may bring an action to enforce any provisions of 780 CMR R6 and M.G.L. c. 142A, in superior court, the district court, or the small claims division of the district court.

R6.5.3.2 Owner right to arbitration: In the alternative, an owner may request that a dispute resulting from and relating to residential contracting be decided under the terms of a private arbitration service approved by the secretary.

R6.5.3.3 Contractor right to arbitration: The home improvement contractor may initiate dispute resolution through private arbitration services approved by the secretary, provided: that the contract between the owner and the home improvement contractor contains such a clause as provided in 780 CMR R6.5.2.5.

R6.5.4 Validity of contract: Contracts which fail to comply with the requirements of 780 CMR R6 and M.G.L. c. 142A shall not be invalid solely because of noncompliance.

780 CMR R6.6 SUPPLEMENTARY IDENTIFICATION CARDS

R6.6.1 Definitions

Certificate of registration: The document issued by the Director showing the registrant's certificate number and other data as required by the director.

Identification card: The document issued to the responsible individual or to one or more individuals in the employ of the applicant/registrant.

R6.6.2 Certificates of registrants: For applicants registering as individuals, the certificate of registration and identification card will be issued in the name of the registrant. Only one identification card will be issued to individual registrants.

R6.6.2.2 Non-Individual Registrants:

R6.6.2.2.1 If the Applicant is a corporation, partnership, proprietorship with a fictitious name, or other non-individual entity, the certificate of registration and the initial identification card will bear the name of the registrant entity and the individual responsible for the home improvement residential contracting activities of the registrant.

R6.6.2.2.2 Supplementary identification cards may be issued, upon request of the registrant, to named officers, partners, of key individuals in the employ of the registrant under the certificate of registration number of the applicant entity, upon submission of the appropriate request form and fee. The applicant is responsible for the prompt return of individual identification cards if there is a change in status of individuals holding such supplementary cards.

R6.6.3 Fees: For each additional identification card request in accordance with 780 CMR R6.2.2.1, an additional fee per card in an amount of $10.00 must accompany the request for additional cards.

R6.6.4 Expiration: Supplementary cards will expire on the same date as the expiration date of the registrant entity, and must be renewed along with the renewal of the registrant entity's registration by submission of the required application and fee of $10.00 per card requested.

780 CMR R7

CERTIFICATION OF INSPECTORS OF BUILDINGS, BUILDING COMMISSIONERS AND LOCAL INSPECTORS

FORWARD

Contained herein are the *RULES and REGULATIONS* for the certification of all inspectors of buildings, building commissioners and local inspectors (collectively referred to as building code enforcement officials) of the Board of Building Regulations and Standards (BBRS). In accordance with M.G.L. c. 143 §§3 and 94, the BBRS is authorized to adopt rules and regulations which govern the administration of such program.

780 CMR R7 covers the certification rules and regulations for inspector of buildings, building commissioners and local inspectors as defined in M.G.L. c. 143, § 3, and 780 CMR 105.

General Provisions

R7.1.1 Title
R7.1.2 Definitions
R7.1.3 Scope, intent
R7.1.4 Powers and duties
R7.1.5 Inspector Certification Advisory Committee (Building Official Certification Committee)
R7.1.6 Categories of certification
R7.1.7 Certifications required

Requirements for Initial Certification

R7.2.1 Application
R7.2.2 Building Code Enforcement Officials in office as of November 12, 1992
R7.2.3 After November 12, 1992
R7.2.4 Requirements for certification as a local inspector
R7.2.5 Requirements for certification as an inspector of buildings/building commissioner

Requirements for Maintenance of Certification

R7.3.1 Continuing education
R7.3.2 Renewal of certification

Procedures for Complaints

R7.4.1 Complaints
R7.4.2 Revocation of certificates and alternate sanctions
R7.4.3 Violations and penalties

780 CMR R7.1 GENERAL PROVISIONS

R7.1.1 Title: 780 CMR R7 entitled "Certification of Inspectors of Buildings, Building Commissioners and Local Inspectors" (hereinafter collectively referred to as Building Code Enforcement Officials) is authorized and promulgated by the State Board of Building Regulations and Standards under the authority of M.G.L. c. 143, §§ 3 and 94.

R7.1.2 Definitions: Any terms not herein defined shall assume the definition of the term as used in the Massachusetts State Building Code (780 CMR).

BBRS: State Board of Building Regulations and Standards

Registrant: Any individual registered with the Board of Building Regulations and Standards (BBRS) as a building code enforcement official in the capacity of an inspector of buildings/building commissioner or local inspector.

R7.1.3 Scope, intent: 780 CMR R7 shall control all matters relating to qualifications and certification of all building code enforcement officials engaged in or to be engaged in the administration and enforcement of 780 CMR, categories of certified building code enforcement officials; procedures for application, issuance, denial and revocation of certifications; approval of training and/or educational programs offered to meet the requirements for certification; maintenance of certification through continuing education; application fees for certification; and enforcement of 780 CMR R7.

It is the purpose of 780 CMR R7 to establish standards and procedures for certification, and to require all persons performing duties with respect to the inspection of building construction for any political subdivision within the Commonwealth to be certified as provided in 780 CMR R7.

R7.1.4 Powers and Duties: The BBRS, working through the Administrator and the Board staff, shall have the following responsibilities in addition to all others provided in 780 CMR R7.

R7.1.4.1 Upon recommendations from the Building Official Certification Committee, established under 780 CMR R7.1.5, to issue certifications to individuals deemed qualified as provided for herein.

R7.1.4.2 To maintain accurate records of all applications for certification and any official action thereon and to make such records available for inspection by the public at all reasonable times.

R7.1.4.3 To suspend or revoke a certification provided for herein upon the establishment of good cause.

R7.1.4.4 Any person aggrieved by any notice, action, ruling or order of the Board, or the Building Official Certification Committee with respect to 780 CMR R7, may have a right to a hearing as provided for by law.

R7.1.5 Inspector Certification Advisory Committee (Building Official Certification Committee):

R7.1.5.1: There is hereby established in the BBRS the Inspector Certification Advisory Committee hereafter known as *the Building Official Certification Committee*. This Committee shall be supported by such staff of the BBRS as may be required for the effective operation of 780 CMR R7.

R7.1.5.2 Powers and Duties: The Building Official Certification Committee shall have the responsibility to advise and to recommend to the BBRS on all items relating to the certification of building code enforcement officials, including, but not limited to:

a. issuance of certificates
b. review of credentials of applicants
c. maintenance of applicant records
d. hearing of complaints and appeals pertaining to inspector certification
e. review and approval of all courses of study, seminars, and other educational programs as deemed necessary, for credit toward continuing education requirements.
f. monitoring all appointments to assure compliance with 780 CMR R7.
g. reciprocity may be considered upon petition of the Building Official Certification Committee on forms provided for such purpose.

R7.1.5.3 Make-up of the Committee: The *Building Official Certification Committee* shall consist of nine members appointed by the BBRS as follows: (Terms of committee members are as established by lot at the March 31, 1993 meeting.)

a. One member of the BBRS or his/her designee
b. Six members who are active building officials consisting of:
- One member from each of the three Municipal Building Official's Associations
  (Southeastern Building Officials Association, Building Officials of Western Massachusetts, Massachusetts Building Commissioners and Inspectors Association).
- Three members at large to be appointed by the BBRS.

c. One member from academia who is an educator of construction at the college level (e.g. architectural, civil, structural) to be appointed by the BBRS.
d. One member of the Massachusetts Municipal Association.

R7.1.6 Categories of Certification:

R7.1.6.1 Categories of certification for building code enforcement officials are as follows:

R7.1.6.1.1 Inspector of Buildings or Building Commissioner: An individual certified as an inspector of buildings building commissioner shall perform the duties as defined in 780 CMR 105.3 and M.G.L. c. 143.

R7.1.6.1.2 Local Inspector: An individual certified as a local inspector shall perform the duties as defined in 780 CMR 105.4 and M.G.L. c. 143.

R7.1.6.1.3 Conditional appointment of a building code enforcement official: A conditional appointee shall meet the requirements of 780 CMR R7.1.7.4 through 1.7.6.3.

R7.1.6.1.4 Alternate inspectors of buildings/ building commissioners: An alternate inspector of buildings/building commissioner shall be certified prior to appointment.

R7.1.7 Certifications required:

R7.1.7.1: After November 12, 1992, no individual shall be permanently appointed to the position of inspector of buildings, building commissioner or local inspector in a local enforcing agency for which a certification requirement has been established by 780 CMR R7, unless that individual has been deemed qualified and certified in that category by the Building Official Certification Committee.

R7.1.7.1.1 Conditional appointments: Conditional appointments may be made pursuant to 780 CMR R7.1.7.4, 1.7.5 and 1.7.6.

R7.1.7.2 Reporting by appointing authorities: Immediately upon the appointment of an inspector of buildings, building commissioner or local inspector, the appointing authority shall notify the BBRS in writing on forms provided for such purpose of the name of the appointee, the appointed position and the date of appointment.

R7.1.7.3: Any individual employed as inspector of buildings, building commissioner or local inspector and who was in office on November 12, 1992 and who was qualified (in accordance with M.G.L. c. 143, § 3) to be in office at time of hire, and who has presented acceptable evidence of these facts to the BBRS, shall be deemed certified in the category held on said date, and shall be provided with a certificate by the BBRS.

R7.1.7.4 Conditional Appointments: After November 12, 1992, individuals who meet or exceed the experience requirements pursuant to M.G.L. c. 143, § 3 and 780 CMR but who are not certified under the provisions of 780 CMR R7 may be appointed on a conditional basis only.

R7.1.7.5 Regulations for the Conditional Appointment of Building Code Enforcement Officials:

R7.1.7.5.1: Any individual conditionally appointed as a building code enforcement official, on or after November 12, 1992 who is not certified in the appropriate category of certification at the time of the conditional appointment; shall comply with the following:

a. Immediately upon appointment, the appointing authority shall report the conditional appointment to the BBRS in accordance with 780 CMR R7.1.7.2.

b. Within the first six months of employment the conditional appointee shall make application to take the examination(s) required for the appropriate category of certification as identified in 780 CMR R7.2.0.

c. Within one year following the first six months of employment the conditional appointee shall attain a passing score on all of the examinations required for the category of certification of the conditional appointment.

d. In accordance with 780 CMR R7.1.7.6, a conditional appointee may petition the Building Official Certification Committee in writing for an extension of time to comply with the examination schedule of 780 CMR R7. Upon establishment of cause, the Building Official Certification Committee may grant such extensions of time as it may consider appropriate.

R7.1.7.5.2: Conditional appointees shall notify the BBRS of any change in the status of their employment, within one month of such change.

R7.1.7.6 Requests for Extensions of Time to Comply with Examination Schedules:

R7.1.7.6.1: Any conditional appointee unable to comply with the examination schedule as cited in 780 CMR R7.1.7.5 may, for cause, be granted an extension of time in order to comply, upon written petition to the *Building Official Certification Committee*. Petitions shall be forwarded to the clerk of said committee, and addressed to the office of the BBRS (current address listed at the front of the building code). The conditional appointee shall state all reasons to substantiate the request for an extension of time.

R7.1.7.6.2: The Building Official Certification Committee shall, within ten days of any action taken by the committee pursuant to 780 CMR R7, notify the appointing authority in writing of such action.

780 CMR R7.2 REQUIREMENTS FOR INITIAL CERTIFICATION

R7.2.1 Application: Any candidate for certification in any category of building code enforcement official issued pursuant to 780 CMR R7 shall submit an application to the BBRS, accompanied by the required application fee as prescribed, on forms provided for this purpose by the BBRS. The application shall include such information and documentation as the BBRS may require pursuant to 780 CMR R7.

R7.2.2 Building Code Enforcement Officials in Office as of November 12, 1992: Upon receipt of acceptable evidence as established by the BBRS, signed by the city or town clerk and the appointing authority in attestation that the applicant for certification was employed in the position of inspector of buildings, building commissioner or local inspector and met the qualificational requirements of said position pursuant to M.G.L. c. 143, § 3 and 780 CMR as of the date of hire, the applicant shall be deemed certified in the applicable category and shall be issued a certificate. The certificate shall indicate the name of the individual and the category of certification and other information as may be deemed necessary by the BBRS.

R7.2.3 After November 12, 1992, applicants for certification as a Building Code Enforcement Official shall meet the following requirements:

R7.2.4 Requirements for certification as a Local Inspector:

R7.2.4.1: All candidates shall meet or exceed the qualifications for the position of local inspector pursuant to M.G.L. c. 143, § 3 and 780 CMR prior to any examinations. The Board of Building Regulations via the certification committee shall approve all candidates prior to any examinations. The certification committee shall maintain a list of all qualified candidates for any and all city and towns appointing building officials.

R7.2.4.2: All candidates shall attain a passing score in all examinations required for certification as *either* a **Building Plans Examiner** *or* a **Building Inspector** under the Construction Code Inspector Certification Program of the Building Officials and Code Administrators International (BOCA).

R7.2.4.3 Prior approval for examination as a Local Inspector: No candidates shall be allowed to take said examinations without prior approval of the Board of Building Regulations and Standards or the certification committee at the Board's discretion.

R7.2.5 Requirements for Certification as an Inspector of Buildings/Building Commissioner:

R7.2.5.1: All candidates shall meet or exceed the qualifications for the position of local inspector pursuant to M.G.L. c. 143, § 3 and 780 CMR prior to any examinations. The Board of Building Regulations via the certification committee shall approve all candidates prior to any examinations. The certification committee shall maintain a list of all qualified candidates for any and all city and towns appointing building officials.

R7.2.5.2: All candidates shall meet the examination requirements for certification as a local inspector pursuant to 780 CMR R7.2.4.2 herein, or hold a certification as a local inspector pursuant to 780 CMR R7.

R7.2.5.3: All candidates shall attain passing scores in all examinations required for certification as a **Certified Building Official** under the Certified Building Official Program of the Council of American Building Officials (CABO).

R7.2.5.4 Prior approval for examination as a Local Inspector: No candidates shall be allowed to take said examinations without prior approval of the Board of Building Regulations and Standards or the certification committee at the Board's discretion.

780 CMR 7.3 REQUIREMENTS FOR MAINTENANCE OF CERTIFICATION

R7.3.1 Continuing education:

R7.3.1.1: Within each three year period following initial certification, the registrant shall complete 45 hours of continuing education credit acceptable to the Building Official Certification Committee.

R7.3.1.2: The Committee may publish a list of acceptable educational programs, courses, seminars, and the like. The Committee may also accept educational activities in which registrants have participated after the fact, upon application and review of the course information. The Committee shall assign credits to each educational/training event.

R7.3.2 Renewal of certificate:

R7.3.2.1 Term of certificate: Each certified individual shall maintain a record of his/her continuing education credits and forward such information to the office of the BBRS in care of the Building Official Certification Committee (address is listed at the front of the building code) as it is accumulated. The BBRS shall maintain a record of each inspector's progress.

At the end of each three year period, each inspector who has successfully maintained his/her continuing education credit shall be duly notified by the BBRS.

R7.3.3: In accordance with M.G.L. c. 143, § 99, no building code enforcement official attending BBRS required educational programs, shall lose any rights relative to compensation or vacation.

780 CMR R7.4 PROCEDURES FOR COMPLAINTS

R7.4.1 Complaints:

R7.4.1.1 Cause for complaint: Any individual who has been alleged to have violated the provisions of 780 CMR R7 or 780 CMR may be entitled to a hearing in accordance with M.G.L. c. 30A before *the Building Official Certification Committee* or subcommittee thereof. A complaint shall be made in writing to the BBRS, attention; *Building Official Certification Committee.*

R7.4.1.2 Hearings on complaints: If a hearing is to convene, the committee shall give at least ten days notice to all those party to the complaint. The sending of notice to the address recorded on the records of the BBRS shall be deemed sufficient notice.

R7.4.1.3 Notice of hearings: The notice shall contain:

a. The name of the complainant
b. A copy of the complaint
c. The date, time and place of said hearing.

The complete file of complaint shall be available for inspection at the office of the BBRS during regular business hours. Parties may present written or oral evidence to refute or mitigate any charge contained in the complaint and present witnesses in his/her behalf. In the event that the committee votes to take action against said certification pursuant to this hearing, the building code enforcement official, upon notice of the decision, shall immediately comply with said orders.

R7.4.1.4 Continuation of hearings: the committee, in its discretion, may continue the date for hearing upon request by building official, the complainant or the committee itself.

R7.4.1.5 Timing of decisions: The committee shall make a decision within 15 days of the hearing. A written decision shall be issued within 30 days of the hearing date.

R7.4.1.6 Decisions: The decision shall be final and binding upon the building code enforcement official and the complainant.

R7.4.1.7 Notice of action: In the event that the committee votes to take action against said certification pursuant to this hearing, the building code enforcement official, upon notice of the decision, shall immediately comply with said orders.

R7.4.1.8 Appeal: Any person aggrieved by a decision of the committee may appeal such decision to a court of law or equity in conformance with M.G.L. c. 30A, § 14.

R7.4.2 Revocation of certificates and alternative sanctions:

R7.4.2.1: The BBRS, upon recommendation of the Committee, and subject to the requirements of the Administrative Practices in accordance with M.G.L. c. 30A, may suspend or revoke a certification, or assess any other penalties as provided for by law, if it is determined that the registrant: (The following is not an exhaustive list.)

a. Has obtained a certification by fraud or misrepresentation, or the person named in the certificate has obtained it by fraud or misrepresentation;

b. Has aided or abetted in practice as a certified building code enforcement official any person not authorized to practice as a certified building code enforcement official under the provisions of 780 CMR R7;

c. Has fraudulently or deceitfully practiced as a certified building code enforcement official,

d. Has been grossly negligent or has engaged in misconduct in the performance of any of his duties;

e. Has failed, over a period of time, to maintain continuing education requirements as specified in 780 CMR R7;

f. Has been found to have failed to report an offer, or bribe, or other favor in a proceeding under 780 CMR R7 or other appropriate law of this or any other state or jurisdiction;

g. Has made a false or misleading statement, or has made a material omission in any submission to the BBRS;

h. Has failed to enforce the provisions of 780 CMR as prescribed by M.G.L. c. 143, § 3.

R7.4.3 Violations and Penalties:

R7.4.3.1: It shall be a violation of 780 CMR R7 on or after November 12, 1992, for any individual to represent himself/herself to be qualified for a position that the individual does not currently hold, or to use a title or otherwise represent himself/herself to be qualified for a position that the individual does not currently hold, or to use a title or otherwise represent himself/herself as certified or authorized to act under the 780 CMR if that individual does not possess a certificate, unless such person is appointed subject to the provisions of 780 CMR R7 1.6.1.3. In addition to any other remedy available under law, such representation shall be deemed a violation of 780 CMR R7 and any other penalties as provided for by law.

R7.4.3.2: It shall be a violation of 780 CMR R7 on and after November 12, 1992, for any local enforcing agency to offer employment, to retain for employment or to permanently appoint any individual who is not certified in accordance with 780 CMR R7, except on a conditional basis in accordance with 780 CMR R7.1.6.1.3.

NON-TEXT PAGE

INDEX

By section number

A

A, use group, assembly, 303.0

Access
  - Attics, 1211.2
  - Courts, 1212.4
  - Crawl spaces, 1211.1
  - Roofs, 1027.0

Accessibility, 780 CMR 11

Accessory structures
  - Definition, 202.0, 3602.2
  - Use Group U, utility and miscellaneous, 312.0

Adjoining property
  - Demolition and excavation, 3310.0
  - Existing buildings, 3309.0
  - Fences, 3311.0
  - Grade control, 3310.4
  - Notice to owners, 3310.1
  - Protection of, 3308.0
  - Storage of materials, 3312.0

Adjoining spaces
  - Natural light, 1206.0
  - Natural ventilation, 1208.0

Administrative
  - Administration, Chapter 1, 3601.0
  - Alternate materials and methods, 109.3
  - Application for permits, 106.2
  - Board of appeals, 122.0
  - Building classified by code official, 302.1
  - Certificate of occupancy, 120.0
  - Code official approves plans, 109.0
  - Code official, definition, 202.0
  - Conditions of permit, 111.0, 113.0
  - Drawings and specifications required, 110.8
  - Existing structures, 102.5
  - Foundation permits, 108.7, 111.13
  - Inspections required, 115.0
  - Inspectors appointed, 105.1
  - Liability, 105.7
  - Maintenance of buildings, 103.1, 3401.2
  - Organization of building department, 105.0
  - Permit fees, 114.0
  - Permits required, 110.1, 110.2
  - Powers and duties of code official, 105.0
  - Records of department, 105.8
  - Requirements not in code, 102.2, 102.3
  - Restrictions on employees, 105.6
  - Revocation of permits, 111.12
  - Scope of code. 101.2
  - Stop work orders, 119.0
  - Tests and test reports, 1708.0
  - Unsafe structures,121.0
  - Validity of code, 104.0
  - Violations and penalties, 118.0

Aged, homes for
  - Use Group I, institutional, 308.0

Aggregates
  - Concrete, 1906.3
  - Masonry, mortar and grout, 2105.0
  - Special tests, 1906.3.1

Air ducts (see Ducts)

Air intakes
  - Combustion, 3620.0
  - Courts, 1212.5
  - From attic areas, 3620.3, 3620.3.3
  - From under floor areas, 3620.3, 3620.3.4
  - Return, 3619.2
  - Supply, 3619.3

Air plenum (see Plenums)

Airplane hangars (see Garages)

Airport traffic control towers, 414.0

Air-supported structures
  - Membrane structures, general, 3103.0
  - Temporary, 3104.0

Aisles
  - Assembly, Use Group A, 1011 .3, 1012.0
  - Exit access, other use groups, 1011.0
  - Illumination, 1024.0

Alarm systems (see Fire protection systems)

Allowable areas and heights of buildings (also see Areas, building)
  - Existing buildings, 3400.3
  - General, 503.0, Table 503
  - Unlimited areas, 507.0

Allowable spans
  - Floor joists, 3605.2.3.1
  - Headers, 3606.2.6
  - Rafters and ceiling joists, 3608.2.4

Alloys
  - Aluminum, 2002.1
  - Special steel, 2207.1

Alterations
  - Additions, 3404.2, 3408.2.3 , 3408.4
  - Area and height limitations, 3404.9
  - Certificate of occupancy, 120.0
  - Definition, 202.0
  - Existing buildings, 3400, 3404.0
  - Inspections, 115.0
  - Light and ventilation in existing buildings, 3400.6
  - Minor changes, 3404.1
  - Nonstructural alterations and repairs, 3401.2
  - Permit fees,114.0
  - Permit required, 111.0
  - Signs, 3102.4.2
  - Structural alterations and repairs, 3404.0

Alternative materials and construction
  - Approved by code official, 109.0, 3601
  - Board of appeals, 122.0
  - Suitability of, 1707.1

Aluminum alloys, 2002.0

Amendments to plans, 110.12, 110.13

Anchorage, anchors
  Flood-resistant construction, 3107.5.2
  Framing into girders, 2305.6.1
  Intersecting masonry walls, 2111.2
  Masonry, general, 2110.0, 2111.0
  Masonry, veneer, 1405.5
  Metal veneers, 1405.4.1
  Projecting masonry, 2112.0
  Wood, sill, 2305.16
Antennas, radio and television, 3109.0
Apartment house (see Multiple dwellings)
Appeals, board of, 122.0
Application for permit
  Action by code official on application. 111.1
  Application form, 110.4
  Awnings, 3205.0,
  Conditions of permit, 113.0
  Drawings required, 110.8
  For demolition of buildings, 112.0
  Foundation permits, 108.7, 111.13
  Moving buildings, 3407.1
  Permit fees, 114.0
  Plot diagram required, 107.6
  Records to be kept, 105.8
  Registered architect or engineer, 107.3
  Signs, 3102.4
  Swimming pools, 421.3
  Temporary structures, 3104.0
  What required, 110.0, 111.0
  When required, 110.0, 111.0
Appointment of code official, 105.1
Approval
  Alternative materials and methods of construction, 109.3
  Certificate of occupancy, 120.0
  For use of plastic material, 2601.3
  General, 106.0
  Inspections, 115.0
  Materials, 1704.0
  Modifications, 106.2
  Moving buildings, 3407.0
  Of plans for permit, 108.5
  Used materials, 109.2
Approved, definition, 202.0, 3602.2
Approved agency
  Criteria, 1704.3 .1
  Definition, 202.0
Architect
  Report, permits issued, 116.4
  Drawings and specifications, by, 110.8
  Special professional services, 116.2
Architectural trim (see Exterior trim restrictions)
Areas, building
  Allowable areas for buildings (also see Allowable areas and heights of buildings), 503.0, Table 503, 3408.6.2
  Allowable, required reductions of, 506.4, Table 506.4
  Definition, 202.0
  Existing buildings, 3404.1
  Floor area, definition, 202.0
  General area limitations, 503.0
  Increase for street frontage, 506.2
  Increase for suppression, 506.3
  Mezzanines, 505.2
  Modifications, 506.0, 506.4
  Open parking structures, 406.4
  Separate buildings, 313.1.3, 503.1, 402.16
  Special industrial uses, 503.1.1
  Unlimited areas, 507.0
  Waiting rooms, 409.2 .1
Areaways, 3203.12.1
Artificial light, 1207.0, 1024.1
Asphalt roof shingles, 1507.2.3, 3609.3
Assembly buildings
  Aisles, 1 012.0
  Area allowed, 503.0
  Classification of, 303.0
  Determining capacity of means of egress, 1009.0
  Fire suppression requirements, 904.0, 914.0
  Occupancy load requirements, 1008.0
  Stages and platforms, 412.0
  Use Group A, 303.0
Atriums, 404.0
Attic
  Access, 1211.2
  Combustion air, 3620.3.3
  Definition, 202.0
  Draftstopping, 720.7.2
  Furnaces, insulation in,
  Insulation, exposed, 722.2
  Ventilation of, 1210.1
Auditoriums
  Foyers and waiting spaces, 1006.2.4
  Means of egress, 1006.2.2
  Use Group A-1, assembly, 303.2
  Use Group A-3, assembly, 303.4
Automatic fire detection systems (see Detection systems, automatic fire)
Automatic fire suppression systems (also see Sprinklers)
  Atriums, 404.2
  Carbon dioxide systems, 909.0
  Covered mall buildings, 402.10
  Dry-chemical systems, 910.0
  Foam systems, 911.0
  General, 901.0
  Halogenated systems, 912.0
  High-rise buildings, 403.2, 403.3
  Limited area systems, 907.0
  Plans and specifications (construction documents), 903.1
  System selection, 905.0
  Water sprinkler systems, 906.0
  Where required, 904.1
Automobiles, parking
  Open parking structures, 313.2, 406.0
  Private garages, 202.0, 407.0
  Public garages, 202.0, 402.16, 408.0
Awnings
  Clearance, 3205.0
  Covers and boxes, 3203.10
  Fixed, 3205.3
  Loads, 1609.0
  Moveable, 3205.2
  Over public property, 3203.9, 3205.1
  Permit for, 3205.1
  Plastic, 2604.8
  Retractable. 3205.2

B

B, use group, business, 304.0

Balcony
  Exits, 1006.2.2
  Exterior balconies, 3203.8
  Exterior construction of, 1406.4
  Live loads, 1606.0
  Over public property, 3203.8
  Permissible street projections, 3203.8
  Railings, 1012.8, 1021.4, 1615.5
  Steps, 1012.0

Banner and cloth signs, 3102.12.1

Barricades
  Construction, where required, maintenance, 3304.2, 3310.1

Bars, reinforcing
  Clear cover in concrete footings, 1810.3.2
  Details of reinforcement, 1910.0, 1911.4
  Reinforcing steel, 2208.0

Basement
  Dampproofing, 1813.0
  Definition, 202.0
  Enclosure of stairways, 1014.11
  Fire suppression system required, 904.10
  Floors above, protection of, 1006 3.1
  Ratproofing, 1215.0
  Required exits, 1010.2
  Stairway construction 1014
  Underground structures, 405.0
  Waterproofing, 1813.0

Bathrooms
  Light and ventilation, 1205.0
  Mechanical ventilation allowed, 1205.2
  Window area required for, 1208 2

Bay window (also see Windows, bay)
  Construction of, 1406.5
  Over public property, projection, 3203.7

Beams
  Bottom flange protection, 715.6
  Fireresistance, rating of, Table 602, 715.0
  Fireresistance, reinforced concrete, Table 602
  Reinforced concrete 1901.
  Steel, formed, 2206.0
  Steel, structural, 2203.0
  Structural, glued-laminated, 2307.1
  Supports, 3605.2.4
  Wood, 2303.0, 2305.0
  Wood in heavy timber construction, 2304.0

Bearing (Loadbearing)
  For wood beams and girders, 2305.6.1, 2305.6.3
  On hollow masonry units. 1812.3.3. 2112.1.2.2

Bearing partitions (see Walls)

Bearing, soil capacity, 1804.0

Bearing walls (see Walls)

Bleachers, 1013.0

Blocks concrete masonry units (see Masonry)

Board and care facilities (see 1, use group, institutional)

Board of appeals, 121.0

Boarding houses (see Residential buildings)

Bond, masonry
  Foundation walls, 1812.3.5
  Masonry veneers,1405.5
  Masonry walls, 2110.0, 2111.0

Borings and tests of soils, 1802.0, 1803.0, 1804.0

Bracing
  Adjoining existing buildings, 3309.3
  Exterior stud walls, 2305.7
  For stud walls and partitions, bearing, 2305.4.2
  Masonry walls, lateral, 2108.0
  Seismic, 1903.0, 1904.0, 2104.0. 2204.0, 2305.8, 2306.0

Brick (see Masonry)

Bridges
  Over sidewalks (wrecking), 3304.3
  Pedestrian walkways, 3106.0

Bridging, wood floors, 2305.14.2

Building
  Allowable areas and heights, 503.0, Table 503
  Alterations of existing buildings, 3400.0, 3404.0
  Ceiling height, 3603.8
  Certificate of use and occupancy, 120.0
  Change in use, 3400.3
  Classified by type of construction, 602.1
  Classified by use or occupancy, 302.1
  Construction precautions, Chapter 33
  Definition, 202.0
  Design criteria, 3603.1
  Doors, 3603.11
  Exits, 3603.10
  Flood resistant, 3107.0
  Garages, 3603.5
  General limitations, Chapter 5
  Glazing, 3603.20
  Height, definition, 202.0
  Height modifications, 504.0
  Heights, allowable, 503.0, Table 503, 504.0, 507.1
  High-rise, 403.0
  Historic, 3409.0
  Maintenance, 103.0
  Permissible street projections, 3203.0
  Room dimensions, 3603.7
  Stairways, 3603.13
  Temporary, 110.2
  Two or more on same lot, 503.1.3, 1201.2
  Unlimited area, 507.0
  Unsafe, 121.0

Building department
  Annual report, 105.5.1
  General, 1 05.0
  Records, 106.7

Building official (see Code official), 202.0

Building paper, 1405.3.6

Building permits (see Permits)

Business buildings, Use Group B, 304.0

C

Caisson piles, 1824.0

Calculations required, 110.8

Canopies
  Construction, 3105.0, 3205.4
  Loads, 1609.6.2
  On exterior walls, 3205.4
  Over public property, 3205.1

Carbon dioxide extinguishing system (see Automatic fire suppression systems)

Cast iron, 2209.0

Cast stone
  Bonding, 2110.0
  General requirements, 2105.3

Cavity walls
  Definition (see Walls), 202.0, 3606.6

Ceilings
  Finishes, 3608.5
  Fireresistance rated assemblies, 713.0
  Height 1204.0, 3603.8
  Panels, 713.1.1
  Plenums, 2805.0

Cellar (see Basement)

Cement
  Concrete, materials, mixes, 1906.0
  Stucco, 2506.0
  Water-cement ratio, 1908.2

Central-station system
  Definition, 202.0
  Fire suppression system supervision, 923.1

Ceramic tile
  Mortar, types and mix, 2105.10
  Veneers, 1405.5

Certificate of occupancy
  Definition, 202.0
  Existing buildings,120.2, 120.3, 120.4
  General, 120.1
  Temporary occupancy, 120.3

Change of use, 202.0, 3400.0, 3405.0

Changes in plans, 110.1

Changes to buildings
  Alterations, 3400.1, 3404.0
  Existing, 3400.1
  Rehabilitation, 3400.1, 3404.0

Chases (see Masonry)

Chemicals
  High-hazard use group, 307.0

Child day care center
  Use Group E, 305.0
  Use Group 1-2, 308.3.1
  Use Group R, 310.5.1

Chimneys
  Chimneys and fireplaces, 3610.0
  Clearance, 3610.2.14
  Crickets, 3610.2.16
  Design, 3610.0
  Factory Built, 3610.3
  Firestopping, 3610.2.15
  Flue lining, 3610.2.7, 3610.2.8
  Load, 3610.2.4
  Masonry,
  Multiple flue, 3610.2.9
  Support, 3610.2.1
  Termination, 3610.2.5
  Wall thickness, 3610.2.6

Churches
  Use Group A-4, assembly, 303.0

Chutes
  Linen and refuse, 2807.0

Classification
  Of buildings, by code official, 302.1
  Of buildings, by occupancy, 302.0
  Of buildings, by types of construction, 602.0
  Of types of construction, 603.0, 604.0, 605.0, 606.0

Clay tile
  General, 2105.0
  Veneer, 1405.0

Clearances
  Around concrete reinforcing, 1810.3.2
  Around fireplaces, 2114.6
  Around timber in masonry, 2305.6.3
  Awnings, movable, 3203.9, 3203.10, 3205.2
  Marquee awnings, 3203.11
  Minimum ceiling heights, 1204.0
  Of balconies above grade, 3203.8
  Of wood above grade, 2311.4.2
  Projection over sidewalks, 3203.0
  Under first floor joists, 1210.2

Coal pockets, 418.3.1.6

Code official
  Appoints inspectors, 105.1
  Charge of building department (duties and powers), 106.1
  Classifies building, 302.1
  Definition, 202.0
  Deputies, 104.4
  Duties and powers of, 105.0, 106.0, 110.0
  Inspections by, 106.4, 115.0
  Issues permits, 105.0, 106.2, 108.0
  Liability, 105.7
  Record of permits required, 105.8
  Records, official, 105.8
  Reports, 105.5
  Rule-making authority, 108.1

Columns
  Cast-iron construction, 2209.4.1
  Concrete-filled pipe, 1912.0
  Fireresistance and protection of, Table 602, 715.0
  Fireresistance tests, 704.0
  Heavy timber construction, 605.1, 2304.0
  Live load reduction, 1608.0
  Working stresses, cast iron, Table 2210.2

Combustibility tests, 704.7

Combustible
  Dusts, grain processing and storage, 307.4, 418.3.1
  Fibers, 307.5
  Liquids, 307.4, 418.3.2

Combustible materials
  Decorative material restrictions. 807.0
  Definition, 202.0
  Exterior trim restrictions, 1406.0
  Flameresistance tests, 807.2
  Insulation, 707.4, 722.0
  Interior trim, 803.5
  Permitted in noncombustible construction, 602.4, 806.0

Compliance with permit, 113.3

Computations, required, 107.7

Concealed spaces, 605.1, 720.6.1, 720.7.2, 722.3

Concentrated loads, 1613.0

Concrete
  Aggregates, 1906.3
  Caissons, 1824.0
  Cementitious material, limitations, 1907.1.2.2
  Columns, concrete-filled pipe, 1912.0
  Definition, 202.0
  Ducts, 3619.1
  Floors (on grade), 3605.5
  Footings, 1810.0
  Minimum dimensions, 1905.0
  Piles, 1818.0, 1819.0, 1820.0, 1821.0
  Pipes in, 1909 3
  Plain concrete, 1901.2, 1904.0
  Reinforced (also see Reinforced concrete), 1901.1, 1910.0
  Shingles, 3609.6
  Shotcrete, 1911.0
  Units (also see Masonry), 2105.1
  Weathering, 3604.2.2

Concrete, masonry blocks (see Blocks, concrete masonry units)

Condensation, 1210.0, 1405.3.10

Condition of permits, 113.0

Construction
  Approval of materials, etc., 109.0, 1704.0
  Basement walls, 3604.4
  Cavity wall masonry, 3606.6
  Classification of construction materials, 1707.0
  Concrete, 1908.0
  Covered by code, 102.0
  Fences, 3304.2
  Footings, 3604.3
  Foundations, 3604.0
  General requirements, 602.0, 1701.0
  Grouted masonry, 3606.7
  Inspection, 115.0, 1705.0
  Masonry, 2112.0, 3606.4
  Metal, 3608.4
  Reinforced hollow masonry, 3606.7.4
  Roof-ceiling, 3608.0
  Stage, 413.2
  Steel, 2203.0, 2205.0, 2206.0, 2207.0, 2209.0, 2210.0
  Types of construction, 603.0, 604.0, 605.0, 606.0
  Wall, 3606.0
  Wood, 2305.0

Construction operations
  Demolition, 3310.0
  Excavation, 3310.0
  Existing buildings, 3309.0
  Fire hazards, 3305.0
  General, 3301.0
  Lighting, 3315.0
  Retaining walls, 3311.0
  Storage, materials, 3312.0

Conveyors, 3010.0

Cooling towers 1510.

Coping
  Flashing, 1405.3.10
  On retaining walls, 1825.4

Corbeling
  Foundation walls, 1812.5
  Masonry, 2112.2

Cornices
  Masonry, 2112.2.1
  Projections, 3203.3
  Type of construction, 1406.0

Corridors
  Arrangements, 1006.2, 1011.1
  Capacity of egress width, 1009.0
  Dead ends, 1011.2
  Definition. 202.0
  Fireresistance ratings, Table 602
  Height, 1204.1
  Obstructions, 1011.1
  Prohibited use, 1005.0
  Widths, 1009.2, 1011.3

Courts
  Definition, 1202.0
  General, 1212..1
  Obstructions, 1213.0
  Permissible encroachments, 1213.2

Covered mall buildings
  Definition, 402.2
  General, 402.0
  Smoke control systems, 921.1

Coverings
  For exterior stairs, 1014.12
  For exteriors, weather protection, 1405.2.1, 3607.3
  Interior finishes, 803.0, 3607.2
  Roofs, Chapter 15, 3609.0
  Wall, 3607.0

Crawl spaces
  Foam plastics, 2603.4.1.4
  Plenums, 2805.1
  Ventilation, 1210.2, 3604.9
  Waterproofing, 1813.1.2, 3604.9.1

Curtain boards, 922.3

Curtain wall
  Ratproofing, 1215.0

Curtains (also see Decorations)
  Atrium separations, sprinkler obstructions, 404.5
  Decorative material restrictions, 404.3, 807.1
  Proscenium, 412.3.6

D

Dampers
  Fire, accessibility, 717.3
  Fire, approved type, 717.1
  Fire, definition, 202.0
  Where required, 717.2

Dampproofing 1813.0

Dance halls
  Use Group A-2, assembly, 303.2

Dangerous structures,121.0

Day care facilities (see Child day care center)

Dead loads
  Decay, 3603.22
  Definition (see Load), 202.0
  Design, 1605.0

Decisions of board of appeals, 122.4

Decorations (also see Interior finish and trim)
  Atriums, 404.3
  Curtains, 404.5, 412.3.6, 807.1
  Flameresistance tests, 807.2
  Restrictions, 807.1
  Stages, 412.3.5.1
Decorative features
  Projections, 3203.4
Definitions, 202.0
Deflection criteria, 604.5.1, 709.3.2, 2308.2.6
Demolition
  General, 112.0
  Permit, when required, 112.1
  Standpipes maintained, 3305.3.4
  Unsafe buildings, 121.0, 121.5
Depth of footings
  Governed by frost line, 1806.1
  Governed by loading, 1805.0
Design
  Approved by code official, 1704.1
  Cast-in-place concrete piles, 1820.0
  Composite piles, 1823.1
  Dead load, 1605.0
  Fire protective requirements (see Fire protection systems)
  Formed steel construction. 2206.1
  Foundation walls, 1812.1
  General 1601.0
  Glass, glazing, 2402.0, 2403.0
  Live loads, 1606.0, 1607.0
  Lumber and timber construction, 2303.1
  Masonry wall construction, 2101.0
  Plain concrete, 1901.2
  Plastics, 2603.0
  Precast concrete piles 1821.1
  Proscenium curtains, 412.3.6
  Reinforced concrete, 190.1
  Retaining walls, 1825.2
  Safe load, 1604.0
  Seismic (earthquake), 1612.3
  Signs, general requirements, 3102.6
  Special steels, 2207.1
  Steel pipe and tapered tubular piles, 1819.0
  Wind loads,1611.0
Detection systems, automatic fire (also see Fire protection systems)
  Airport traffic control towers, 414.3
  Approval, 918.3
  Atriums, 404.6
  Definition, 202.0
  General requirements, 918.0
  High-rise buildings, 403.4
  HPM facilities, 416.9.2
  Plans and specifications, 918.2
  Sprinklered buildings exception, 918.5
  Use Group 1-2, 409.5.1
  Where required, 918.4
  Zones, 918.6
Deviations
  From code, 109.3
Devices for window cleaning, 3110.0
Display of permit, 111.14
Doors
  Air-supported structures, 3104.8
  Approved type, fire, 716.1, 716.2
  Arrangement, 1006.2, 1017.2.3
  Automatic-closing devices for, 716.5
  Bolts, surface, 1017.4.1.1
  Corridors 409.3.1, 1011.1.3, 1011.4.2
  Egress, means of, 1017.0
  Exterior walls, 706.4
  Fire (see Fire doors)
  Fire partitions, 711.0
  Fire separation assemblies, 709.0
  Fire walls, 707.0
  In horizontal exits, 1019.2
  Location of, 1006.0, 1017.4
  Panic hardware, 1017.4.2
  Power operated, 1017.4.3
  Rated fire door assemblies, 716.1
  Required to open out, 1014.8.2, 1017.4
  Revolving, 1018.0
  Stairways, exterior, 1014.12
  Stairways, interior, 1014.8, 1014.11
  Security grilles, 1017.5
  Signs, 1017.4.1, 1017.4.1.2
  Smokeproof enclosures, 1015.4.1, 1015.5.1. 1015.5.2, 1015.6.1
  Stages, 412.3.4
  Use Group 1-2, 409.3.1
  Use Group 1-3, 410.3, 410.4
  Width of, 1017.3
  Wired glass in, 719.2
Dormers, 1510.6
Dormitories
  Definition (see Dwellings), 202.0
  Use Group R-1, residential, 310.0
Doubtful use classification, 302.1
Downspout
  For roofs, 3203.11.3
  Materials, 1406.0
Draftstopping
  Definition, 202.0
  General, 720.0
Drainage
  Foundation systems, 1813.5
  Marquees, 3203.11.3
Dressing rooms (see Theaters)
Dry cleaning plants
  General, 418.3.4
  Use group classification, 306.0
Drying rooms, 2806.0
Drywall (see Gypsum board)
Ducts
  Fire dampers required in, 717.0
  Firestopping openings, 720.6.4
Dumbwaiter
  Definition, 202.0
Dusts, combustible, 307.2, 418.3.1

- Duties
  - Of board of appeals, 122.0
  - Of code official, 106.0
- Dwellings
  - Area and height limitations, general, 503.0, Table 503
  - Ceiling height, 1204.1
  - Definition, 202.0
  - Fire partitions in, 310.5, 711.4
  - Floor area, minimum, 1204.2
  - Use Group R, residential, 310.0

E

- E, use group, educational, 305.0
- Earthquake (seismic) design
  - Concrete,1903.0,1904.0
  - Foundations, 1810.2.1, 1815.2.1, 1816.3, 1816.7.1, 1816.11.1, 1818.3 1819.3, 1820.1.2, 1820.5.4, 1821.3.5, 1821.3.6, 1824.3
  - Inspection related to 1705.3.3.2, 1705.4.5, 1705.9, 1705.10, 1705.11
  - Loads, 1612.0
  - Masonry, 2101.2, 2104.0
  - Soils,1802.1.1,1805.2,1805.3
  - Steel, 2203.2, 2203.2.1, 2204.0, 2206.3, 2207.2.1
  - Wood, 2305.8, 2305.9, 2306.0
- Eaves
  - Construction, 1406.0
  - Draftstopping, 720.7.2
  - Projection, 3203.0
- Educational buildings, Use Group E, 305.0
- Egress (see Means of egress)
- Electrical equipment and systems, Chapter 27
- Elevated walkways, 3106.0
- Elevators, 3000.0
- Emergency
  - Controls, proscenium curtains, 412.3.6.4
  - Escape, 1010.4
  - Lighting, 1024.0
  - Signs for exits, 1023.0
- Emergency electrical systems (also see Standby power systems)
  - High-rise buildings, 403.9.3
- Emergency measures
  - Closing streets, 121.5
  - Cost of emergency repairs, 121.5
- Emergency repairs, 121.2,121.4
  - Temporary safeguards, 121.3
  - Vacating structures, 120.1
- Employees, restrictions on, 105.6
- Enclosure
  - For elevators, 3007.1.1
  - For interior stairs, 1014.11
  - For motion picture projection rooms, 411.2
  - Of exterior stairways,1014.12
  - Ramps, 1016.0
  - Shafts, 710.0
- Enclosure walls (see Walls)
- Encroachments
  - Awnings and canopies, 3203.9
  - Court, 1213.0
  - Existing, 3202.6
  - General, 3201.0
  - Special and temporary, 3204.0
  - Street, 3202.0
  - Yard, 1213.0
- Energy conservation
  - Alternative systems, 1316.0
  - Exceptions, 1301.4
  - Exterior envelope requirements, 1309.0, 1314.0
  - General, 1300.0
  - In electrical distribution systems, 1312.0
  - In mechanical systems, 1310.0, 1311.0
  - In water heating systems, RESERVED
  - Plans and specifications, 1303.0
- Enforcement of code, 106.0
- Engineering calculations, 107.7, 110.8
- Engineering practice, 116.0
- Escalators, 1006.6, 3001.0
- Excavations
  - Protection of, 3310.0
  - Protection of adjoining property, 3308.0
  - Walkways over, 3304.3
- Exhaust systems
  - Contaminants to outdoor air, 1208.3
  - Spray spaces, 419.2
- Existing buildings
  - Additions, alterations, repairs, Chapter 34
  - Areas, allowable, Table 503, 3404.9
  - Certificate of occupancy, 120.0
  - Change in existing use, 3405.0
  - Change of occupancy, 3405.0
  - Condemnation of, 119.1
  - Continuation of, 102.2
  - Definition (see Building), 202.0
  - Demolition, 112.0
  - General requirements, 3400.1
  - Inspection of, 106.4, 106.5, 115.0
  - Moving, 102.5.6, 3407.0
  - Nonstructural alterations and repairs, 3404.4
  - Protection during construction operations, 3304.0
  - Roof coverings, 1512.0
  - Unsafe, 121.0
- Existing electrical installations, 2708.0
- Existing signs, 3401 0
- Exit lights, 1023.0, 1024.0
- Exit signs, 1023.0
- Exits (see Means of egress), 3603.10
- Expiration of permit 111.7
- Explosion hazards, 307.3, 417.5.1
- Exterior envelope
  - Definition, 202.0
  - Requirements, 1301.0,1305.0, 1309.0. 1314.0
- Exterior opening, protection required, 706.0
- Exterior stairways,1014.12
- Exterior trim restrictions, 1406.0, 705.1.2

Exterior walls
  Fireresistance ratings, 507.2, Table 602, 705.0
  General, Chapter 14
Extinguishers, fire, 920.0

F

F, use group, factory and industrial, 306.0
Faced (veneered) walls (see Walls)
Factory buildings
  Use Group F, factory and industrial, 306.0
  Use Group H, high-hazard, 307.0
Fasteners
  Roof construction, 1505.2, 1507.0
  Schedule, Table 2305.2
  Weather coverings, 1405.3.7
  Wood construction, 2305.2
Fees
  For demolition, 112.2
  For moving of buildings, 112.2
  For new construction and alterations, 114.3
  For signs, 112.2
  General, 114.0
  Payment of, 113.1
  Refunds, 112.5
  Schedule, 114.3.1
  Special, 114.2
Fences
  Excavations, 3310.0
  For construction purposes, 3304.2
  General requirements, 3311.0
  Use Group U, 312.0
Film
  Projection rooms, 411.0
  Storage and use of flammable film, 411.1
Finish, interior (see Interior finish and trim)
Fire
  Alarm system (see Fire protection system)
  Area, definition, 202.0
  Dampers, 717.0
  Firestopping, 202.0, 720.0
  Hydrants, 916.0
  Sprinklers and standpipes, 904.0, 906.0, 914.0, 915.1
Fire department
  Central control station for, 923.0
  Connections, 915.0, 915.2
Fire detection systems, 918.0
Fire doors
  Closing devices, 716.5
  Corridors, 1011.4.2
  Definition (see Doors), 202.0
  Dressing rooms, 412.5.2
  Exterior walls, 706.0
  Fire partitions, 711.3
  Fire separation walls, 709.3
  Fire walls, 708.3
  General, 704.3, 716.0
  Horizontal exits, 1019.2.1
  Proscenium walls, 412.3.5
  Shafts, 710.3.1
  Smoke barriers, 712.3
  Stage enclosures, 412.3.4
  Stairways, 1014.9
  Wired glass, 716.4, 719.0
Fire escapes
  General, 1025.0
  Maintenance of. 1028.0
Fire extinguishers, 920.0
Fire protection systems
  Area increased by, 506.3
  Automatic fire detection systems, 918.0
  Automatic fire detection, where required, 918.4
  Carbon dioxide extinguishing system, 909.0
  Design, 903.1.3
  Dry-chemical extinguishing system, 910.0
  Fire department connection, 915.0
  Foam-extinguishing system, 911.0
  General requirements, 901.0
  Halogenated fire-extinguishing system, 912.0
  Height increased by, 504.2
  Limited area sprinkler system, 907.0
  Manual fire alarm system, 917.0
  Manual fire alarm system, where required, 917.4
  Nonrequired systems, 901.3
  Outside sprinklers, 706.2
  Plans and specifications, 903.0
  Smoke control systems, 921.0
  Standpipes, where required, 914.2
  Supervision, 923.0
  Suppression system selection, 905.0
  Temporary standpipe requirements, 3305.3
  Water-spray fixed systems, 908.0
  Water sprinkler system, 906.0
  Where required, 904.1
  Yard hydrants 916.0
Fire pumps, power source, 403.9.1.3
Fire separation distance, 202.0, 507.1, Table 602, 705.0
Fire shutters, 718.0
Fire suppression system (see Automatic fire suppression systems)
Fire towers (see Smokeproof enclosure), 1015.0
Fire walls, 707.0
Fire windows, 718.0
Fireplaces, 2114.0, 3610.0
Fireresistance ratings
  Assemblies, Table 602, 704.0
  Definition, 202.0
  Exterior opening protectives, 706.0
  Exterior walls, 705.0
  Fire dampers, 717.0
  Fire doors, 716.0
  Fire partitions, 711.0
  Fire separation walls, 709.0
  Fire wall openings, 708.0
  Fire walls, 707.0
  Fire windows, 718.0
  Floor construction, 709.0, 713.0
  General, 701.0
  Plans and specifications, 703.1
  Roof construction, 714.0
  Shafts, 710.0
  Smoke barriers, 712.0
  Special requirements, 504.6, 504.7
  Structural members, 715.0
  Tests, 704.0

- Fireresistance ratings of structure elements, Table 602
- Fireretardant-treated wood
  - Labeling, 2310.2.2
  - Strength modifications, 2310.2.1
  - Tests, 2310.2
  - Use limitations, 2310.1
- Firestopping
  - Architectural trim, 720.6.5,1406.2.4
  - Between wood sleepers, 806.2
  - Definition, 202.0
  - Floor/roof ceiling assemblies, 720.0, 720.7.1, 3606.2.7
  - General requirements, 720.0, 720.1
  - Of attic spaces, 720.0, 720.7.2
- Flag poles, 1510.1
- Flameresistance
  - General, 807.2
  - Interior floor finishes, 805.0
  - Interior hangings and decorations, 807.0
  - Interior trim, 803.5
  - Interior wall and ceiling finishes, 803.4
  - Tests, 807.2.2
  - Textile wall coverings, 803.6
- Flammable liquids, 307.0, 417.0, 418.0
- Flashing, 1405.3.10
- Floodproofing, 3107.0
- Floor
  - Area, 503.0, Table 503, 506.0, 507.0
  - Assemblies, construction, 713.0
  - Combustible materials permitted in Types 1 and 2 construction, 602.4, 806.0
  - Concrete, 3605.5
  - Metal, 3605.6
  - Treated-Wood, 3605.4
  - Wood, 3605.2
- Floor
  - Area, definition, 202.0
  - Level of exit discharge protection, 1006.3.1
  - Loads, 1606.0
  - Public garages, 408.3.3
  - Ratproofing, 1215.0
  - Theater stages, 412.3.1
  - Wood panel sheathing, 2307.3.1
- Floor openings
  - Atriums, 404.0
  - Public garages, 408.3.3
  - Shaft enclosure exceptions, 713.3
- Floor surface at doors, 1017.1.1
- Foam-extinguishing systems, 911.0
- Foam plastics
  - Diversified tests, 2603.8
  - Exterior walls, 2603.4.1.8
  - General, 2603.1
  - Insulation, 722.0, 2603.4.1.5
  - Interior finish and trim, 804.3.1, 2603.7
  - Labeling, 2603.2
  - Prescriptive installations, 2603.4.1
- Footings
  - Allowable loads, 1804.0, 1805.0
  - Concrete, design, 1810.0, 3605.2
  - Depth, 1806.0
  - Design, 1807.0
  - Forming, 1810.6
  - Frost Protection 1806.1
  - Masonry, 1811.0
  - Prepared fill, 1705.7
  - Reinforced concrete, 1810.3.2
  - Soils report, 1804.1
  - Steel grillage, 1809.0
  - Timber, 1808.0
- Formed steel construction, 2206.0
- Foundation systems
  - Allowable loads, 1805.0
  - Caissons, 1824.0
  - Cripple walls, 3606.2.8
  - Design, 1812.1
  - Footings (see Footings)
  - For neighboring building, 3310.2
  - May project beyond property line, 3202.4
  - Minimum depth, 1806.0
  - Minimum thickness, 1812.3
  - Piers, 1815.0
  - Piles, 1816.0 through 1824.0
  - Ratproofing, 1215.1
  - Steel grillage, 1809.0
  - Walls, 1812.0
  - Wood and timber, 1808.0
- Frame construction, wood
  - General requirements, 2303.0, 2305.0, 2306.0
- Frost protection
  - Depth of footings, 1806.2

G

- Garages
  - Beneath a dwelling, 407.3
  - Construction of public garages, 408.3
  - Definition, 202.0
  - Fire doors, 407.6
  - Open Parking structures, 406.0
  - Private, 407.0
  - Public, 408.0
  - Separations, 407.3, 407.4, 407.7
  - Storage of flammables, 408.4, 408.5
  - Ventilation, 408.5
- Garages, private
  - Connected to dwelling, 407.3, 407.4, 407.7, 3603.5
  - Definition, 202.0
  - Use Group U, utility and miscellaneous, 312.0
- Garages, public
  - Construction limited, 408.3
  - Definition, 202.0
  - Fire suppression system required, 408.3.1
  - Use Group S-1, storage, 311.0
  - Ventilation required, 408.5
- Gardens, roof, 1008.3
- Gas
  - Hazardous, 307.0, 417.0, 418.1
- Glass and glazing
  - Area required for natural light, 1206.2, 1208.2
  - Atrium enclosure, 404.5
  - Block reinforcement, 2115.4
  - Block walls, 2105.5, 2115.0
  - Dimensional tolerances, 2402.4
  - Doors, 2405.2
  - Fire windows, 718.0
  - Greenhouses, 2404.4
  - Guards, 2406.0

  - Handrails, 2406.0
  - Impact loads, 2405.1
  - In fire doors, 718.0, 719.2
  - Jalousies, 2402.5
  - Labeling, 2402.1
  - Plastic (see Light-transmitting plastics)
  - Protected openings, 718.0, 719.0
  - Racquetball and squash courts, 2407.0
  - Safety, 2405.0, 3603.20.4
  - Skylights, 2404.0
  - Sloped, 2404.0
  - Supports, 2402.2
  - Unsupported edges, 2402.3
  - Veneer, structural, 1405.7
  - Wind loads, 1611.0, 2403.1
  - Wired glass, 719.0

- Glazed masonry units, 2105.2
- Glazing (see Glass and glazing)
- Glued-laminated lumber construction, 2313.1
- Grade
  - Definition, 202.0
  - Depth of footings and foundations below, 1806.0, 1808.0, 1810.0, 1812.0
- Grading a lot, 3310.4
- Grain processing and storage, 418.3.1
- Grandstands, 1002.1, 1013.0
- Greenhouses
  - Glazing, 2404.4
  - Membrane structure materials, 3103.3.2
- Grounding
  - Metal veneer, 1405.4.3
  - Radio and television antennas, 3109.3
  - Radio and television towers, 3108.5
- Group homes
  - Use Group 1-1, institutional, 308.0
- Grout (also see Mortar), 2105.0
- Guards
  - Balconies, 1005.5
  - General, 1021.0, 3603.14.2
  - Glass in, 2406.0
  - Open parking structures, 406.5
  - Retaining walls,1825.5
  - Stairways, 1014.7
  - Structural design, 1615.5, 1615.8
  - Wheel 406.6, 408.3.2
- Gutters
  - For roof, 3203.11.3
  - Materials, 1406.0
- Gypsum
  - Construction, 2504.0
- Gypsum board
  - Installation, 2503.3
  - Materials, 2503.0
  - Standards. 2503.2, 3607.2.3

H

- H, use group, high-hazard, 307.0
- Habitable space
  - Definition, 202.0
- Halogenated extinguishing systems, 912.0
- Handicapped and aged. requirements for, Chapter 11, 3006.3
- Handrails
  - Details, 1022.2
  - General, 1022.0, 3603.14
  - Grandstands and bleachers, 1022.0
  - Ramped aisles, 1012.5
  - Ramps, 1016.5, 1022.2
  - Retaining walls, 1825.5
  - Stairways, 1014.7, 1022.2
  - Structural design, 1615.5
- Hardware on exit doors, 1017.4
- Hazardous uses
  - General, 416.0, 417.0, 418.0
  - High-hazard, 307.0
  - Low-hazard, 311.1
  - Moderate-hazard, 311.2
  - Production materials (HPM), 416.0
  - Prohibited locations, 313.2
  - Storage segregation, 417.0
- Headroom
  - Ceiling heights, 1204.1
  - Ramps, 1016.2.2
  - Stairways, 1014.4
- Hearth for fireplace, 2114.5, 3610.4.5, 3610.5.1
- Heated space, definition, 202.0
- Heating systems
  - Fireplaces, 2114.0
  - Gas-fired equipment, 2801.2
  - General requirements, 2801.0
- Heavy timber construction, 605.0, 2306.1
- Height
  - Awnings, 3203.9, 3203.10
  - Buildings (see Height, buildings)
  - Ceiling, 1204.1, 3603.8
  - Guards, 1021.2
  - Handrails, 1022.2.2
  - Marquees, 3203.11.1
  - Masonry veneers, 1405.5.1
  - Parapet walls, 705.6
  - Permissible street projections, 3203.0
  - Stairway, maximum vertical rise, 1014.5
  - Towers, spires, cupolas, aerial supports, poles, etc., 1510.0
- Height, buildings
  - Airport traffic control towers, 414.0
  - Allowable, 503.0, Table 503
  - Alterations for existing buildings, 3403.1, 3404.4
  - Covered mall buildings, 402.1, 402.7
  - Day care centers, 504.4
  - Definition, 202.0
  - High-rise, 403.1, 403.3.3.1
  - HPM facilities, 416.3
  - Membrane structures, 3103.3.5
  - Modifications, 504.0
  - Open parking structures, 406.4
  - Restrictions, 503.3, 507.1
  - Special industrial uses, 503.1.1
  - Unlimited area buildings. 507.0

- High-hazard
  - Accessory areas to, 302.1.2.1
  - Application of flammable finishes, 419.0
  - Classification, 302.1.2.1
  - Control areas, 307.8, 417.2
  - Definition, 307.2
  - Exceptions, 307.8
  - Exempt quantities, 307.8, Table 307.8(1), Table 307.8(2)
  - Explosion control, 417.5.1
  - Flammable and combustible liquids, 418.3.2
  - Hazardous materials, 417.0
  - Liquefied petroleum gas distribution facilities, 418.3.3
  - Multiple hazards, 307.7
  - Outside storage, dispensing and utilization, 417.6
  - Unlimited area structures, 507.1, 507.1.2
  - Use group requirements, 417.0, 418.0
  - Use group structure height exemption, 504.5
  - Use groups, 307.0
- High-rise buildings
  - Alarm and communication systems, 403.5, 403.6
  - Applicability, 403.1
  - Automatic sprinkler system, 403.2, 403.3
  - Central control station, 403.7
  - Elevators, 403.8
  - Emergency systems, 403.9
  - Exits in, 403.10
  - Maintenance and inspection, 901.4
  - Seismic consideration in, 1612 6
  - Smoke detection systems, 403.4
- Historic buildings and districts, 3409.0
- Homes for aged
  - Use Group l-1, institutional, 308.2
- Horizontal exits
  - Definition (See Means of egress), 202.0
  - General requirements, 1019.0
- Hospitals
  - Use Group l-2, institutional, 308.3
- Hotels
  - Definition (see Dwellings), 202.0
  - Use Group R-1, residential, 310.3
- House, lodging
  - Use Group R, residential, 310.0
- HPM use facilities, 416.0
- Hydrants, fire yard systems, 916.1

I

- I, use group, institutional, 308.0
- Identification for plastics, 2601.4
- Identification for signs, 3102.4.5
- Illuminated signs, 3102.13
- Industrial
  - Use Group F, factory and industrial, 306.0
- Industrial heating appliances, classification, 2801.2.1
- Infirmaries
  - Use Group 1-2, institutional, 308.3
- Inner court
  - Definition (see Courts), 202.0
- Insane asylums
  - Use Group 1-3, institutional, 308.0
- Inspection
  - By code official, 105.4, 106.4, 115.0
  - Final, 115.5
  - Of electrical wiring, 2704.0
  - Of existing buildings, 106.4
  - Of heating systems, 2804.0
  - Of prefabricated construction, 113 2.2
  - Of signs, 3102.5.4
  - Of unsafe buildings, 121.0
  - Required preliminary, 115.1, 115.2
  - Special, 202.0, 1705.0
- Insulation
  - Fiberboards for roof, 2309.3
  - Fiberboards for wall. 2309.4
  - Foam plastics, 803.3.1, 2603.0
  - Thermal insulating materials, requirements, 722.0
- Interior environmental requirements, Chapter 12
- Interior finish and trim
  - Application of, 804.0
  - Classification of materials, 803.2, 803.4
  - Decorative material restrictions, 807.1
  - Flame spread of, 803.2, 803.4
  - Flameresistance tests, 807.2
  - Floor finishes, 805.1, 805.2
  - Foam plastics, 803.3.1, 2603.0
  - General requirements, 803.0
  - Lath, 3607.2.2
  - Plaster, 3607.2.2
  - Restrictions in Types 1 and 2 buildings, 806.0
  - Special amusement buildings, 413.6
  - Textile wall coverings, 803.7
  - Use group requirements, 803.4, Table 803.4
- Interior lot lines
  - Definition (See Lot), 202.0

J

- Jails
  - Use Group 1-3, institutional, 308.4
- Jalousies
  - Windows and doors, 2402.5
- Jurisdiction
  - Adopting this code, 101.1

L

- Label, definition, 202.0
- Labeling, 1703.1.1, 1704.3
- Landing of stairs,1014.3.2, 1014.5
- Landings of ramps, 1016.4
- Lathing and plastering, 2505.0, 2506.0
- Liability, code official, 105.7
- Licenses
  - Fees for, 114.0

Light, illumination
  Artificial, 1207.0, 3603.6.5
  Court requirements for, 1212.0
  For existing buildings, 3401 0
  For exit signs, 1023.0
  General, 1201.0
  Natural, 1206.0
  Required, 1205.0
  Window requirements, 1206.2

Light-transmitting plastics
  Approved types, 2604.1
  Bathroom accessories, 2604.7
  Connections, 2604.3
  Definition (see Plastics), 202.0
  Glazing of unprotected openings, 2606.0
  Light-diffusing systems, 2604.5
  Partitions, 2604.6
  Roof panels, 2607.0
  Skylights, 2608.0

Linen chutes, 2807.0

Lintel
  Fire protection, 715.2
  Masonry support, 1405.5.2
  Over openings, frame construction, 2305.11

Liquids
  Flammable and combustible, 307.4, 417.3, 418.3.2
  Liquefied petroleum gases, 307.4, 418.3.3

Load design, 1604 0, 1605.0, 1607.0, 1708.0

Load earthquake (see Earthquake design)

Load, glass
  Impact loads, 2405.1
  Jalousies, 2402.5
  Wind loads, 2403.1

Load, impact
  Assembly structures, 1614.5
  Craneways, 1614.4
  Definition, 202.0
  Elevators, 1614.2
  General, 1614.1
  Machinery, 1614.3

Load (live, dead, floor)
  Combination of, 1616.0
  Concentrated, 1613.0
  Craneways, 1614.4
  Definition, 202.0
  Deflections allowable, 1604.5
  Documentation of, 1603.0
  Earthquake, 1612.0
  Floor loads, occupancy, 1606.1, Table 1606.1
  Footings and foundations, 1805.0, 1807.0
  For concrete footings, 1807.0, 1810.0
  For retaining wall design, 1615.2
  Glass (see Load, glass)
  Guards, 1615.8
  Impact (see Load, impact)
  Interior finish, 803.7
  Piles, allowable, 1817.0
  Railings, 1615.5
  Reductions allowed, 1608.0
  Roof, 1609.0, 1611.0
  Snow, 1610.0, 3603.1.5
  Soil, bearing capacity, 1804.0
  Special, 1615.0
  Tests, 1604.3
  Uniform, 1606.0
  Wind (see Load, wind)

Load, wind
  Chimneys, 1611.12
  Exterior walls, 1611.0
  General requirements, 1611.0
  Glass, 2403.1
  Roofs, 1609.0,1611.10, 1611.11
  Signs, 1611.12.2

Lobbies and passageways as exits, 1020.0

Lodging houses
  Definition (see Dwellings), 202.0
  Use Group R, residential, 310.0

Lot
  Definition, 202.0
  Interior lot line, definition (see Lot line), 202.0
  Line fences, 3311.1
  Regulations for, 3310.4, 3310.5

Lumber (also see Wood construction)
  Grade of, 2301.1, 3606.2.2

M

M, use group, mercantile, 309.0

Maintenance
  Of exit facilities, 1028.2
  Of fire protection systems, 901.4
  Of signs, 3102.5.2

Malls, covered, 402.0

Manlifts, 3000.1

Manual fire alarm systems, 917.5.1

Marquees and canopies
  Construction requirements, 3105.0, 3203.11.5, 3205.3
  Definition (see Signs), 202.0
  Drainage of water, 3203.11.3
  Signs, 3102.11, 3203.11

Masonry
  Anchorage, 2111.0, 3606.4.10
  Attachment, 3607.3.7.2
  Bonding, 2110.0, 2111.2.1
  Brick, 2105.0
  Cavity wall, 3606.6
  Chases and recesses, 2113.1
  Concrete units, 2105.1
  Construction requirements, 2112.0
  Corbeled and protected, 2112.2
  Cornices, 2112.2.1
  Definition, 202.0
  Design, 2101.1.1, 2101.1.2
  Fireplaces, 2114.0
  Footings, 1811.0
  Foundations, 1812.3.2
  Freezing protection, 2112.3
  General, 3606.4.1
  Glass block, 2115.0
  Glazed units, 2105.2
  Grouted, 3606.7
  Hollow, definition of, 202.0
  Hollow units, 2105.1, 3606.5.1.2.2, 3606.7
  Lateral bracing, 2106.0, 2108.0
  Lintels, 2113 2
  Minimum thickness, 2109..1.1
  Mortar, 2105.7
  Reinforced, 2101.1.1, 3606.7.3

- Reuse of, 2105.6
- Solid, definition of, 202.0
- Solid units, 2105.1, 2105.2
- Stone, cast, 2105.3
- Stone, natural, 2105.3
- Support on wood, 2113.3
- Tests, general, 1701.0
- Tile, structural, 2105.2
- Veneers, 1405.5.3

Matches
- Use Group H, high-hazard, 307.0

Materials
- Alternative, 1701.2
- Approvals, 1704.0
- Used, 1701.3

Matters not provided for, 102.3

Means of egress
- Aisles and aisle accessways, 1012.0
- Arrangement, 1006.2
- Buildings with one exit, 1010.3, Table 1010.3
- Capacity, 1009.0
- Corridors, 1011.0
- Corridors and passageways, required width for, 1011.3, 1012.0
- Definition, 202.0
- Doors, revolving, 1018.0
- Doorways, 1011.4.2, 1014.8, 1017.0, 1018.0, 1019.2.1
- Elevator and escalator restrictions, 1006.6
- Exit signs, 1023.0
- Exterior exit stairways, 1014.12
- Fire escapes, 1025.0
- From places of assembly, 1006.2.2
- General provisions, 1001.0
- Hardware, 1017.4
- Hazards to, 1005.0
- Horizontal exits, 1019.0
- Interior exit stairways, 1014.0
- Length of travel, 1006.5
- Level of exit discharge passageways and lobbies, 1020.0
- Lighting, 1024.0
- Location and type of, 1006.0
- Maintenance of exits, 1028.0
- Number of exits required, 1010.0
- Occupant load, 1008.0
- Opening protectives, 1011.4
- Passageways and corridors. 1011.0
- Prohibited use, 1005.0
- Ramps, 1016.0
- Slidescapes, 1026.0
- Smokeproof enclosure, 1015.0
- Spiral stairways, 1014.6.4
- Stairway, construction, 1014.9
- Through adjoining spaces, 1006.2.1
- To roof, 1027.0

Mechanical ventilation (see Ventilation)

Membrane structures
- Definition, 202.0
- General, 3103.1

Metal siding
- Corrosion protection, 1405.3.8
- Thickness, 1403.3

Mezzanines
- Definition, 202.0
- General, 505.0

Miscellaneous buildings
- Use Group U, utility and miscellaneous, 312.0

Miscellaneous signs, 3102.0

Mixed uses, 313.0

Mobile units, requirements, 420.0

Modification of code provisions
- By board of appeals, 122.0
- Of area, 506.0
- Of height, 504.0
- Variations, 105.6, 106.2, 106.4
- Written, 106.2.1
- Mortar, 2105.7, 2112.0

Motion picture film storage, 411.1

Motion picture projection and screening rooms, 411.0

Motion picture screening rooms, 411.6

Motion picture studios, 411.7

Moved structures, 3407.0

Multiple dwelling
- Definition (see Dwellings), 202.0
- Use Group R-2, residential, 310.0

N

Nails
- Fastening schedule, 2305.2, Table 2305.2

New materials or methods of construction
- Alternative materials and methods of construction, 106.4, 1701.0
- Board of adjustments and appeals, 121.1

Noncombustible construction
- Definition, 202.0
- General, 603.0

Noncombustible material (see Definitions), 202.0, 704.4.1.1

Notices
- Board of appeals meeting, 121.3
- Of violations, 116.1
- Of work starting, 108.9
- Posting occupancy load, 1003.2, 1003.3
- Posting permits, 108.8
- Stop work order, 117.0
- Unsafe buildings,119.3,119.4,120.1

O

Occupancy
- Certificate of, 120.0
- Change in occupancy, 3405.0
- Covered by code, 102.0
- Definition, 202.0

Occupant load
- Allowances, 1008.0, Table 1008.1.2
- Definition, 202.0
- Maximum, 1008.1.5
- Posted, 1003.3

Occupiable room, definition, 202.0
Office buildings
  Use Group B, business, 304.0
Oil storage, 2801.2
Open parking structures
  Height and area, 406.4
  Protective railings, 406.5
  Type of construction permitted, 406.2
  Use Group S-2, storage, low-hazard, 311.0
  Wheel guards required, 406.6
Openings
  Exterior opening protectives, 706.0
  Horizontal protection, 705.3
  In fire partitions, 711.0
  In floors, 713.3
  In shaft enclosure walls, 710.3.1
  On or near exterior stairways, 1014.12.2
  Protected with fire doors or windows, 704.3
  Vertical protection, 705.5
Ordinary repairs, 3401.2
Oriel window
  Definition, 202.0
  Materials, 3203.2
Owner
  Definition, 202.0
  Responsibility, 1401.2

P

Paint
  Of formed steel, 2206.4
  Of structural steel, 2203.5
  Spraying and spray booths, 419.0
  Storage, 419.2.3
Panel walls
  Glass block, 2115.0
  Thickness, 1404.6
Panels
  Stressed skin, 2313.2
Panic hardware, on exit doors, 1017.4
Parapet wall, 705.6, 707.5
Parking structure, open (see Open parking structures)
Particleboard
  Definition, 202.0
  Requirements, 2308.0, 3606.11
Party walls
  Affected by excavations, 3310.0
  Construction of, 707.0
  Continuity, 707.5
  Definition (see Walls), 202.0
  Parapets required, 707.5
  Size and construction of openings, 708.2
Passageways
  Corridors, 1011.0
  Horizontal exits, 1019.0
  Lobbies as exits, 1020.3
  Obstructions prohibited, 1028.1
Pedestrian walkways, 3106.0
Penalties and violations, provided by code, 118.0
Penthouse
  Definition, 202.0
  General requirements, 1510.3
Permits
  Action on applications, 111.1
  Amendments to, 110.14
  Application for, 110.4, 110.13, 110.14
  Approval in part, 110.2.2
  Awnings, 3205.1
  Conditions of, 111.0
  Definition, 202.0
  Electrical, Chapter 27
  Examination of drawings, 108.5
  Expiration, 110.14
  Fees, 114.0
  For awnings and canopies, 3205.1
  Issued upon affidavits, 110.12
  Posting of, 111.14
  Records to be kept 106.6, 106.7
  Required, 107.1
  Revoked, 111.12
  Signs, 3102.4
  Suspension of, 108.2
  Temporary, 110.2.1
  Time limitation, 110.14
  To demolish buildings 112.0
  To move buildings, 3407.0
  Validity, 103.0
  Valuations, 112.0
Petroleum storage
  Flammable and combustible liquids, 417.0, 418.0
  Liquefied petroleum gases, 418.3.3
Piers
  Isolated masonry, 2110.0
Piles
  Cast-in-place concrete, 1820.0
  Composite, 1823.0
  Foundations, 1816.0
  Loads allowable, 1817 0
  Precast concrete,1821.0
  Special, 1824.0
  Steel pipe and tubular, 1819.0
  Structural steel, 1818.0
  Timber, 1822.0
Pipe
  Columns, concrete-filled,1912.0
  Piles, 1819.0
Plans and specifications
  Approval of, 108.5
  Changes in, 107.1
  Required, 107.5, 107.6
Plastering and lathing
  Application, interior, 2505.1
  Exterior, 3607.3.6
  Fireresistance requirements, 721.0
  General requirements, 2505.0, 2506.0
  Gypsum plaster, 2505.0
  Interior lathing and gypsum plastering, 2505.0, 3607.2.2
  Materials, 2505.0
  Portland cement stucco, 2506.0

Plastics
  Approval for use, 2601.3
  Approved, 2601.2
  Bathroom accessories, 2604.7
  Definition, 202.0
  Design and installation, 2604.0
  Fastenings, 2604.0
  Foam, 803 3.1, 2603.0
  Glazing of unprotected openings, 2606.0
  Interior finish and trim, 803.0
  Light-diffusing systems, 2604.5
  Of signs, 3102.6.4 2
  Partitions, 2604.6
  Roof panels, 2607.0
  Scope and use, 2601.1
  Skylights, 2608.0
  Structural requirements, 2604.2
  Thermoplastics, definition, 202.0, 2604.1
  Thermosetting, definition, 202.0, 2604.1
  Veneer, 2605.1
  Wall panels exterior, 2605.1

Platforms
  Construction of, 412.4
  Fire suppression, 412.6

Plenums, 1005.7, 2805.0

Plot plan, required, 110.10

Plumbing
  Certificate of approval, 2904.3
  Existing, 2908.0
  Permits, 2904.0
  Plans and specifications, 2902.0, 2904.1, 2904.2
  Sewer and water supply data, 3404.0
  Violations, 2904.5
  Water supply systems, 2905.0

Plywood, 2307.0, 3607.3.3, 3606.10

Portable signs, 3102.14

Positive heat supply, definition, 202.0

Posting
  Occupant load, 1003.3
  Permits, 111.14
  Unsafe building, 121.0

Projecting signs, 3102.10

Projection rooms
  Construction of, 411.2
  General requirements, 411.0
  Ventilation of, 411.3

Projections from buildings
  Awnings and canopies, 3203.9, 3205.0

Projections
  Balconies and stairs, 3203.8
  Bay windows, 3203.7
  Below sidewalk, 3202.2
  Belt courses, 3203.4
  Cornices and eaves, 3203.3
  General, 3201.1
  In alleys, 3204.0
  Marquees, 3203.11
  Signs, 119.0, 3102.11, 3202.10
  Special and temporary, 3204.0
  Street encroachments, 3202.0
  Street projections, permissible, 3203.0
  Yard and court, 1213.0

Protected construction
  Definition, 202.0

Protection against corrosion
  Formed steel, 2206.4
  Structural steel, 2203.5

Protection against dampness
  Of crawl spaces, 1210.2
  Of foundation walls, 1813.0

Protection against decay and termites, 2311.0, 3603.22

Protection during construction
  During wrecking, 3304.0
  Of adjoining property, 3308.0
  Of excavation, 3310.0

Protection of exterior openings
  Of exterior wall, 706.0, 718.0
  Of fire wall opening, 708.0

Public assembly
  Use Group A, assembly, 303.0

Public way, definition, 202.0

Q

Qualifications
  Of board of appeals, 121.2.1

R

R, use group, residential, 310.0

Radio antennas and towers, 3108.0, 3109.0

Rafters
  Grade of lumber, 3608.2

Railings (see Handrails)

Ramps, 1016.0

Ratproofing, 1215.0

Recesses (see Masonry and Walls)

Records
  Of decisions, 121.6
  Of departments, 104.7

Recreation buildings
  Use Group A, assembly, 303.0

Reductions, live load, 1608.0

Refineries
  Use Group H, high-hazard, 307.0

Reformatories
  Use Group 1-3, institutional, 308.0

Refuse, chutes, 2807.0

Refuse vaults, 2808.0

Reinforced
  Definition, concrete, 202.0
  Foundation walls, concrete, 1812.3.1
  Grouted masonry, 3606.7.3
  Gypsum concrete, 2504.0
  Hollow-unit masonry, 3606.5.1.2.2, 3606.7.4
  Masonry, foundation wails, 1812 3.2
  Walls, 1812.0

Reinforced concrete (also see Concrete)
  Definition (see Concrete), 202.0
  Design,1901 1
  Footings, 1811.0
  Gypsum, 2504.0
  Pipes in, 1909.3
Removal
  Of buildings and structures, 121.3
  Of waste during construction, 3313.0
Repair
  Of existing buildings, 107.1.1, 3401.2, 3404.0
  Of unsafe buildings or structures, 121.0
  Permit not required, 107.1.1
  To roofs of existing buildings, 1512.0
Repair shops, motor vehicle
  Definition (see Garage, public), 202.0
  Public garages, 408.0
  Use Group S-1, storage, moderate-hazard, 311.0
Residential buildings
  Sound transmission control, 1214.0
  Use Group R, 310.0
Restaurants
  Use group A-3, assembly, 303.0
Restrictions
  Area, 503.2
  Height, 503.3
  On employees, 104.5
  Special occupancy, 401.0
Retail stores
  Use Group M, mercantile, 309.0
Retaining wall
  Definition (see Walls), 202.0
  Design, 1825.2
  General, 1825.1
  Guardrails for, 1825.5
Reviewing stands , 1013.0
Revocation of permit, 111.12
Revolving doors, 1018.0
Right of entry, 113.4
Risers for stairways (see Stairways)
Roof construction
  As required by type of construction, 603.0, 604.0, 605.0, 606.0
  Builtup, 3609.7
  Cooling towers, 1510.8
  Covering, 1503.0, 3609.0
  Definition of roof structure, 202.0
  Drainage, 3608.1.3
  Fireresistance requirements, Table 602
  Flashing, 3607.3.8
  Loads, 1609.0, 1611.0
  Mansard or ordinary construction, 510.5
  Of approved plastics, 2604.1, 2607.0
  Parapets above, 705.6, 707.5
  Ponding 1609.5
  Stadiums, 714.2
  Wind loads, 1611.0
  Wood construction, 2305.15
Roof covering
  Classified, 1506.0
  General, Chapter 15
Roof signs, 3102.8
Roof structures, 1510.0
Roofing repairs on existing buildings, 1512.0
Room size, 3603.7
Rooming houses
  Use Group R, residential, 310.0
Rubbish chutes, 2807.0
Rubble stone foundation walls, 1812.3.4
Rule-making authority
  Promulgated by code official, 108.0
Rust protection
  For formed steel, 2206.4
  For structural steel, 2203.5

S

S, use group, storage, 311.0
Safe loads on soil, 1804.0
Safeguards during construction, 3301.0
Safety devices for window cleaning, 3110.0
Sanitariums
  Use Group 1-2, institutional, 308.0
Scale of plans, 107.5
Schools
  Use Group E, educational, 305.0
Scope of code
  General 101.0
Screening rooms, motion picture, 411.0
Screens for skylights, 2404.3
Scuttle
  Scuttle size and construction, 1510.2
Seating
  Aisles and, 1012.0
  Folding and telescopic, 1013.0
Seismic (earthquake) design
  Concrete, 1903.0, 1904.0
  Foundations, 1810.2.1, 1815.2, 1816.3, 1816.11.1, 1818.3, 1819.3.1, 1820.1.2.1, 1820.5.4, 1821.3.5, 1821.3.6, 1824.3
  Inspection related to, 1705.3.3.2, 1705.4.5, 1705.9, 1705.10, 1705.11
  Loads, 1612.0
  Masonry, 2101.2, 2104.0
  Soils, 1802.1.1, 1805.2,1805.3
  Steel, 2203.2, 2203.2.1, 2204.0, 2206.3, 2207.2.1
  Wood, 2305.8, 2305.9, 2306.0
Shaft
  Definition, 202.0
  General, 710.0
Shall, definition, 202.0
Sheathing
  Floor, 2307.3.1, 2307.3.2
  General requirements for, 2307.0, 2308.0, 2309.0
  Roof, 2305.15.1, 2307.3.1, 2308.4
  Subfloor, 2307.3.3
  Wall, 2305.13
Shed
  Sidewalk, 3304.4

Shingles and shakes
  Asphalt shingles, 3609.3
  Materials, 1507.0
  Metal, 3609.5
  Slate, 3609.4
  Tile, clay, or concrete, 3609.6
  Wood shakes, 3609.9
Shutters
  Shutters on exterior wall openings, 718.0
Sidewalks
  Bridge, 3304.3
  Elevated pedestrian walkways, 3106.0
Siding, 3607.3.2
  Minimum material requirements, 1403.3
Signs
  Alley, 119.2.4
  Alterations to, 119.0
  Banner and cloth, 3102.12.1
  Definition, 202.0
  Design loads, 3102.6, 3102.10.4
  Doors, 1017.4.1, 1017.4.1.2
  Exemptions, 3102.4.3
  Existing, 102.2
  Extending over curb prohibited, 3102.10.2
  For exits, 1023.0
  General requirements, 3102.6
  Ground, 3102.7
  Identification, 3102.8.3
  Illuminated, 3102.6.3, 3102.13
  Inspection of, 3102.5.4
  Maintenance, 3102.5.2
  Marquee, 3102.11
  Miscellaneous,3102.12
  Permits for, 3102.4
  Plans and specifications, 3102.4
  Plastics for, 3102.6.4.2, 2601.2
  Pole, 3102.7
  Projecting, 3102.2
  Roof, 3102.8
  Temporary, 3102.12
  Unsafe, unlawful, 119 0
  Wall, 3102.9
  Wind loads,1611.0,3102.6.1
Skylights
  General, 2404.0, 3603.20.5
  Plastic, 2601.2, 2608.1
Slidescapes, 202.0,1026.0
Smoke detection, 3603.16.3
Smokeproof enclosure, 202.0, 1015.0
Snow load 1610.0, 3603.1.5
Soil
  Bearing, allowable, 1804.0, 1805.0
  Bearing capacity, 1804.0,1 805.0
  Prepared fill, 1705.9, 1804.3.2
  Soils report, 1804.1, 1804.1.1
  Tests, 1802.0, 1803.0
Sound stages, motion picture, 411.0
Sound transmission control in residential buildings
  Air-borne noise, 1214.2
  Scope, 1214.1
  Structure-borne sound, 1214.3
Spans
  Allowable, 3605.2.3, 3608.2.4
Special fireresistance requirements
  For grade floor protection, 1006.3.1
  For residential buildings, 313.3
Spray painting
  Booths, 419.2.1
  Construction requirements for booths, 419.2.1
  Fire protection, 419.3
  Rooms 419.2.2
Sprinklers (also see Automatic fire suppression systems)
  Area increase permitted, 506.3
  Capacity of means of egress, width permitted 1009.0, Table 1009.2
  General requirements, 901.0, 906.0
  Length of travel, increase permitted, 1006.5
  Outside, 706.2
  Where required, 904.1
Stadiums
  Roof construction, 714.2
  Use Group A-5, assembly, 303.6
Stages
  Construction, 412.3
  Curtain, proscenium, 412.3.6
  Definition, 412.2
  Fire suppression, 412.6
  Proscenium wall, 412.3.5
  Rooms, accessory, 412.5
  Standpipes, 412.7
  Ventilation of, 412.3.8
Stairways
  Access to roof, 1027.0
  Circular, 3603.13.6
  Definition, 202.0
  Door to stairway, 1014.8
  Enclosures, exterior, 1014.12.2
  Enclosures, interior, 1014.11
  Exterior, 1014.12
  Fire escapes, 1025.0
  Guardrails, 1014.7, 1021.0
  Handrails, 1014.7, 1022.0
  Headroom clearance, 1014.4, 3603.13.3
  Illumination, 3603.13.7
  Landings, width, 1014.3.2,1014.5
  Means of egress, 1010.2,1014.0
  Means of egress lighting, 1024.0
  Rise between landings, 1014.5
  Slidescapes, 1026.0
  Spiral, 1014.6.4, 3603.13.5
  Treads and risers, 1014.1.1,1014.6, 3603.13.2
  Width, 1014.3, 3603.13.1
  Winders, 1014.6.3, 3603.13.4
Standards, referenced, which governs, 101.6, 102.4
Standby power systems, 2707.0
Standpipes
  Definition, 202.0
  During construction, 3305.3
  Water supply, 914.0
  Where required, 914.0
Starting work
  Notice to building official, 108.9

Steel, construction
  Cast-iron construction, 2209.0
  Cast-steel construction, 2208.0
  Definition, 202.0
  Fire escapes, 1025.0
  Grillages in footings, 1809.0
  Joists, open-web construction, 2205.0
  Light gage and formed steel construction, 2206.0
  Painting, 2203.5
  Reinforcing, 2105.9.3, 2105.9.4, 2208.0
  Special steel, 2207.0
  Structural, 2203.0

Steel pipes
  Concrete-filled, 1819.1, 1819.5

Stone
  Cast, 2105.3
  Foundation walls, 1812.3.4
  Natural, 2105.3
  Veneer, 1405.5.6

Stop work orders, 119.0

Storage
  Of combustible dusts, grain processing and storage, 418.3.1
  Of flammable liquids, 418.3.2
  Of liquefied petroleum gas, 418.3.3
  Use Group S, storage, 311.0

Story above grade, definition, 202.0

Street
  Definition, 202.0
  Encroachments, 3202.0
  Permissible projections, 3203.0

Structural clay tile, 2105.2

Structural glass block, 2115.1

Structural panels, wood, Chapter 23

Structural requirements for plastics, 2604.2

Structural steel (see Steel, construction)

Structure
  Definition, 202.0
  Unsafe, 121.0

Stucco, 2506.0

Swimming pools
  Definition, 421.2
  Design and construction, 421.5
  Hot tub, 421.2, 421.10
  Permit and plans, 421.3
  Safety precaution, 421.9, 421.10
  Spa, 421.2, 421.10
  Water supply treatment and drainage system, 421.6

T

Tanks
  Storage of flammable liquids, 418.3.2
  Storage of liquefied petroleum gas, 418.3.3

Telescopic seating, 1013.0

Television antennas and towers, 3108.0, 3109.0

Temporary
  Buildings or structures, 110.2, 3104.0
  Electrical use, 2705.0
  Occupancy, 120.3
  Permits, 111.0
  Safeguards, 120.1
  Signs, 3102.12
  Stairs, 3314.1
  Termination of approval for temporary buildings, 110.2.3

Tents, air-supported structures, requirements, 3104.0

Termite protection
  Approved pressure preservative treatment of wood, 2311.0

Tests
  Fireresistance, 704.1.1
  Flameresistance, 802.0
  General, Chapter 17
  New materials and devices, 1701.2
  Of construction equipment, 3303.0
  Of fire protection systems, Chapter 9
  Pile capacity, 1817.0
  Prefabricated construction, 1703.3
  Procedure for soil, 1803.3
  Soil bearing values, 1804.0
  Structural steel unit, 2203.0
  Ties veneer, 3607.3.7.2.1

Theaters
  Aisles, 1012.0
  Use Group A-1, assembly, 303.2

Thermal insulating materials, 722.0

Thermoplastics, accepted, 2604.0, 2606.3

Thermosetting plastics, accepted. 2604.0

Towers
  Cooling, 1510.8
  Radio and television, requirements, 3108.0
  Wind, loads, 1611.0, 3108 4

Travel, length of, to exits, 1006 5

Treads, stairs, 3402.2

Trim, exterior, 1406.0

Trim, interior (see Interior finish and trim)

Trusses
  Individual encasement, 714.1
  Roof slabs and arches, 714.4
  Roofs, 20 feet or higher, 714.3
  Wood construction, 2305.14, 2305.15, 3605.2.10, 3608.2.11

Tunnel flame spread test, 1702 4.1

Types of construction
  Type 1, noncombustible, 603.0
  Type 2, noncombustible, 603.0
  Type 3, noncombustible/combustible, 604.0
  Type 4, heavy timber, 605.0
  Type 5, combustible, 606.0

U

U, use group, utility and miscellaneous, 312.0
Underground structures, 405.0
Underpinning, 3309.3
Unfired pressure vessels, 2801.2
Unlimited area, buildings, 507.0
Unsafe structures, 121.0
Unusable space, 713.1.2
Use Group
  Doubtful classification, 302.1
  Classification, 302.0
  Mixed use classification, 313.0
Utilities public, discontinuance of
  In demolition of structures. 112.0

V

Validity
  Of code, 104.0
Vapor retarder, 722.3.1, 1403.3
Vaults, refuse, 2808.0
Veneers
  Height of, for frame buildings, 1405.5.1
  Masonry,1405.5, 1405.6, 3607.3.7
  Metal, 1405.4
  Plastic, 1404.6
  Stone and tile, 1405.5.6
  Structural glass, 1405.7
  Wall facings and, 1403.3
  Weather resistance, 1403.3, 3607.3.2
Ventilation
  Attics, 1210.1
  Court requirements for, 1212.0
  Crawl space, 1210.2
  Definition, 202.0
  For existing buildings, 3400.6
  Garages, 408.5
  General requirements, 1201.0
  Mechanical, 1209.0
  Motion picture projection rooms, 411.3
  Natural, 1208.0
  Roof, 3608.6
  Windows, 1208.2
Vertical openings
  Conveyor openings, 3009.1
  Enclosures, 710.4, 710.5
Violations and penalties
  Abatements, 118.5
  Notice of, 118.6
  Penalties, 118.4
  Stop work, 119.0
  Unsafe building 121.0

W

Walkways, pedestrian, 3106.0
Wall signs, 3102.9
Wallboard (also see Sheathing)
  Fiberboard, 2309.0
  For frame construction, 2305.13
  Gypsum, 2503.0, 3607.2.3
  Hardboard, 1403.3
  Particleboard, 2308.0
  Wood structural panel, 2307.0
Walls (also see Masonry)
  Basement, 3604.4
  Bearing, chases and recesses in, 2113.1
  Bearing, lateral bracing of, 2108.2
  Bearing, wood frame construction, 2305.4
  Bonding of, 2110.0, 2111.0
  Bracing, 3606.2.9
  Concrete masonry units, 2105.1
  Construction, 3606.2.3
  Corbeled and projecting masonry, 2112.2
  Definition, 202.0
  Deflection, 3607.3
  Design for wind on vertical surfaces, 1611.0
  Ducts in fireresistance rated walls, 717.0
  Enclosures for theater stages, 412.2
  Exterior protection, 3607.3
  Fire and party, 707.0
  Fire partitions, 711.0
  Fire separation, 709.0
  Fire wall openings, 708.0
  Fireplace, 3610.4.3
  Foundation walls, 1812.0
  Glass block, 2115.0
  Hollow, 2105.1, 2105.2
  Hollow panels, thickness of, 1404.6
  Masonry wall construction, 2113.1
  Panel, 1404.6
  Parapet, 705.6, 707.5
  Penthouse, 1510.3
  Plain concrete, 1901.2
  Proscenium, 412.3.5
  Protection of exterior openings in, 706.0
  Reinforced concrete,1901.1,1910.0
  Reinforced concrete walls, 1812.3.1
  Retaining, 1825.0
  Roof structure, 1510.0
  Shaft enclosure, 710.3.1
  Smoke barriers, 712.0
  Stone foundation, 1812.3.4
  Thickness of panel, 1404.6
  Veneers, glass, 1405.7
  Veneers, metal, 1405.4
  Veneers, plastic, 2605.0
  Veneers thickness of, 1403.3
  Veneers thin and tile, 1405.5.6
Warehouse
  Use Group S, storage, 311.0
Waste chutes, 2807.0
Waste to be removed, 3313.0
Water
  Supply, definition, 202.0
  Supply for plumbing, 2905.0
  Tanks, 1510.7
Waterproofing of exterior structural elements, 1813.0
Waterproofing of foundation walls, 1813.4.2, 3604.6

Welding
  Inspection,1705.3.3.2
Width
  Aisles, 1012.0
  Lobbies used as an exit element, 1020.3
  Means of egress doors, 1017.3
  Stair exit doors, 1014.8.1
    Units of exit width, 1009.1
Wind load design Zoning
  Buildings, 1611.0
  Definition, 202.0, *see Load*
  Glass, 2403.1
  Radio and television towers. 3108.4
  Signs, 1611.12, 3102.6.1
Winders, 1014.6.3
Windows
  Bay, 1406.5
  Cleaning safeguards, 3110.0
  Dormer, t 510.6
  Fire, 718.0
  Fireresistive design, 718.1
  Glass area required, 1206.2,1208.2
  Required for light and ventilation, 1205.0
Wired glass
  In fireresistive doors and windows, 719.0
Wood construction
  Bearing walls, 2305.4
  Bracing, 2305.7
  Bridging, 2305.14.2
  Cambering, 2301.1
  Cornices, 1406.2.2
  Cutting and notching, 2305.3
  Designated type of, 606.1
  Fiberboards, 2309.0
  Fireretardant-treated, 707.5.2, 2310.0
  Flashing, 1405 3.10
  Floor sheathing, 2307.3.1
  Floors, 3605.2
  Foundation anchorage, 2305.16
  Foundation, general, 1812.0, 3604.4.3, 3604.5.2
  Framing around flues and chimneys, 2304.11
  Heavy timber construction, 2304.0
  Nailing, 1405.3 7, 2305.2
  Nonbearing walls, 2305.5
  Piles, 1822.0
  Plywood, 2307.0
  Prefabricated I-joists, 2313.5
  Protection near grade, 2311.4
  Roof-ceiling, 3608.2
  Roof sheathing, 2305.15.1, 2307.3.1
  Shear walls, 2502.0
  Sheathing lath, 2305.13.2
  Shingles and shakes, 1506.3, 1507.2.8, 1507.2.9, 3609.8, 3609.9
  Spans for plywood sheathing, 2307.3
  Stressed skin panels, 2313.2
  Structural glued-laminated timber, 2313.1
  Structural members, 2303.0
  Structural panels, 2307.0
  Stud spacing, 2307.3.5
  Subfloors, 2307.3.3
  Trusses, 3605.2.10, 3608.2.11
  Veneer, height of, 1405.5.1
  Veneer, masonry, 1405 5
  Veneer, metal, 1405 4
  Wall sheathing, 2305.13, 3606.2
  Weatherboarding, exterior, 1403.3
Work
  Start, 111.15
  Stop order, 119.0
Workmanship, 117.0
Written notice
  Definition, 202.0

Y

Yard
  Definition, 202.0
  Obstruction of, 1213.0
  Permissible encroachments, 1213.2
Yard system fire mains, 916.0

THE COMMONWEALTH OF MASSACHUSETTS
William Francis Galvin, Secretary of the Commonwealth
State Publications and Regulations

REGULATION FILING AND PUBLICATION

1. Regulation Chapter, Number & Heading: **780 CMR**
AMENDMENT (01/19/01)

2. Name of Agency: **THE MASSACHUSETTS STATE BUILDING CODE**
STATE BOARD OF BUILDING REGULATIONS & STANDARDS

3. This document is reprinted from the Code of Massachusetts Regulations and contains the following:

780 CMR 1 Administration
780 CMR 3 Use or Occupancy
780 CMR 4 Special Use and Occupancy
780 CMR 5 General Building Limitations
780 CMR 7 Fireresistant Materials and Construction
780 CMR 9 Fire Protection Systems
780 CMR 13 Energy Conservation
780 CMR 14 Exterior Wall Coverings
780 CMR 16 Structural Loads
780 CMR 18 Foundations and Retaining Walls
780 CMR 28 Mechanical Systems
780 CMR 34 Repair, Alteration, Additon & Change of Use of Existing Buildings
780 CMR 36 One & Two Family Dwelling

780 CMR APPENDIX A - Reference Standards
780 CMR APPENDIX B - Sample Building Permit Application Forms
780 CMR APPENDIX H - Historic Buildings
780 CMR APPENDIX J - Energy Provisions
780 CMR R6 -Registration and Enforcement of Home Improvement Contractor Program

Under the Provisions of Massachusetts General Laws, Chapter 30A, § 6, and Chapter 233, § 75, this document may be used as evidence of the original documents on file with the Secretary of the Commonwealth.

Compiled as in full force and effect: **01/19/01** ✓

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A true copy attest:
William Francis Galvin
WILLIAM FRANCIS GALVIN
Secretary of the Commonwealth

Chapter	Remove these pages	Insert these pages
780 CMR 1	15 - 18	15 - 18
780 CMR 3	57 & 58	57 & 58
780 CMR 4	77 & 78	77 & 78
780 CMR 5	115 & 116	115 & 116
780 CMR 7	129 & 130	129 & 130
780 CMR 9	157 & 158	157 & 158
	161 - 164	161 - 164
780 CMR 13	a & b	
	209 - 242	209 - 242.8
780 CMR 14	249 & 250	249 & 250
780 CMR 16	259 & 260	259 & 260
780 CMR 18	313 & 314	313 & 314
	319 - 322	319 - 322
	325 - 328	325 - 328
	331 - 334	331 - 334
780 CMR 28	417 & 418	417 & 418.2
780 CMR 34	445 & 446	445 & 446
	449 - 450.2	449 - 450.2
780 CMR 36	475 - 480	475 - 480
780 CMR Appendix A	657 & 658	657 & 658
	665 & 666	665 & 666
780 CMR Appendix B	681 & 682	681 & 682.2
		708.1 - 708.4
780 CMR Appendix H	745 - 748	745 - 748
780 CMR Appendix J	753 & 754	753 & 754
	760.3 & 760.4	760.3 & 760.4
	760.9 - 760.14	760.9 - 760.14
	760.27 & 760.28	760.27 & 760.28
780 CMR R6	791 & 792	791 & 792

shall have had general knowledge of the accepted requirements for building construction, fire prevention, light, ventilation and safe egress; as well as a general knowledge of other equipment and materials essential for safety, comfort and convenience of the occupants of a *building* or *structure*.

Each inspector of buildings shall be certified by the BBRS in accordance with the provisions of 780 CMR R7, the Rules and Regulations for the Certification of Inspectors of Buildings, Building Commissioners and Local Inspectors.

Municipalities may require additional qualifications or experience as are deemed necessary.

105.4 Qualifications of the local inspector: In accordance with the provisions of M.G.L. c. 143, § 3, each local inspector shall have had at least five years of experience in the supervision of building construction or design or in the alternative a two year associates degree in a field related to building construction or design, or any combination of education and experience which would confer equivalent knowledge and ability, as determined by the BBRS. In addition, such persons shall have had general knowledge of the accepted requirements for building construction, fire prevention, light, ventilation and safe egress; as well as a general knowledge of other equipment and materials essential for safety, comfort and convenience of the occupants of a *building* or *structure*.

Each local inspector shall be certified by the BBRS in accordance with the provisions of 780 CMR R7, the Rules and Regulations for the Certification of Inspectors of Buildings, Building Commissioners and Local Inspectors.

Municipalities may require additional qualifications or experience as are deemed necessary.

105.5 Reporting Requirements:

105.5.1 Annual report by city or town clerk: In accordance with the provisions of M.G.L. c. 143, § 3, the clerk of each city or town shall, annually, not later than April first, transmit to the BBRS the names and official address of each inspector of buildings, building commissioner and local inspector as well as at such other times as required pursuant to 780 CMR R7, the Rules and Regulations for the Certification of Inspectors of Buildings, Building Commissioners and Local Inspectors. Such reports shall be submitted on forms prescribed by the BBRS for said purpose.

105.5.2. New appointments: The clerk of each city or town shall additionally report to the BBRS, the name, capacity and status of any new appointee within the time periods prescribed in 780 CMR R7 on forms prescribed by the BBRS for said purpose.

105.6 Restriction of employees: No full-time or part-time building commissioner, inspector of buildings, or full-time or part-time local inspector as defined herein shall be engaged in, or directly or indirectly connected with, the furnishing of labor, materials or appliances for the construction, alteration or maintenance of a building or structure, or the preparation of plans or of specifications therefore within the city, town or region for which he or she is appointed, unless he or she is the owner of the building or structure; nor shall any officer or employee associated with the building department engage in any work which conflicts with his or her official duties or with the interests of the department.

Note: See M.G.L. c. 143, § 3Z (Local Option law relative to part-time employees).

105.7 Relief from personal liability: Insofar as the law allows, while acting for the municipality, the building official, charged with the enforcement of 780 CMR shall not be deemed personally liable in the discharge of his official duties.

105.8 Official records: An official record shall be kept of all business and activities of the department specified in the provisions of 780 CMR. In accordance with the provisions of M.G.L. c. 66, § 10(b), all such records shall be open to public inspection at all appropriate times and according to reasonable rules to maintain the integrity and security of such records.

780 CMR 106.0 DUTIES AND POWERS OF THE BUILDING OFFICIAL

106.1 General: The inspector of buildings and local inspector (herein after building official) shall enforce all of the provisions of 780 CMR, 521 CMR (Architectural Access Board) and any other state statutes, rules and regulations, or ordinances or bylaws which empower the building official. The building official shall act on any question relative to the mode or manner of construction and materials to be used in the construction, reconstruction, alteration, repair, demolition, removal, installation of equipment and the location, use, *occupancy* and maintenance of all *buildings* and *structures*, except as otherwise specifically provided for by statutory requirements or as provided for in 780 CMR 109.0.

106.2 Applications and permits: The building official shall receive applications and issue permits for the construction, reconstruction, alteration, repair, demolition, removal or change in use or *occupancy* of *buildings* and *structures*; inspect the *premises* for which such permits have been issued and enforce compliance with the provisions of 780 CMR.

106.3 Notices and orders: The building official shall issue all necessary notices or orders to ensure compliance with 780 CMR.

106.4 Inspections: The building official shall make such inspections as deemed necessary to ensure compliance with 780 CMR, or the building official may accept reports of inspection by qualified agencies or individuals, which reports shall be in writing and be certified by a responsible officer of such agency or by the responsible individual.

106.5 Inspection and certification of specified use groups: The building official shall periodically inspect and certify *buildings* and *structures* or parts thereof in accordance with Table 106. A *building* or *structure* shall not be occupied or continue to be occupied without the posting of a valid certificate of inspection where required by Table 106. A certificate of inspection as herein specified shall not be issued until an inspection is made certifying that the *building* or *structure* or parts thereof complies with all the applicable requirements of 780 CMR, and until the fee is paid as specified in Table 106. Municipalities may increase or waive only in their entirety for any specific *use group* the fees as specified in said Table 106.

> **Exception**: Municipalities may revise or modify, or waive in part those fees for *buildings* and *structures* or parts thereof owned by the municipality, county or political subdivision thereof and for *buildings* and *structures* or parts thereof used solely for religious purposes.

TABLE 106
REQUIRED MINIMUM INSPECTIONS AND CERTIFICATIONS FOR SPECIFIED USE GROUPS
(See Chapters 3 and 4 for complete description of *use groups*)

Use Group	Use Group	Use Group Description	Minimum Inspections	Maximum Certification Period	Fees for Maximum Certification Period
A-1	Assembly - Theaters over 400 capacity	With stage and scenery Movie Theater	Semi- Annual Semi- Annual	One Year One Year	$75 $75
A-1	Assembly - Theaters 400 or less capacity	With stage and scenery Movie Theater	Annual Annual	One Year One Year	$40 $40
A-2	Assembly - Night Clubs or similar uses	Over 400 capacity 400 or less capacity	Semi Annual Annual	One Year One Year	$75 $40
A-3	Assembly Lecture Halls, recreation centers, terminals, etc.	Over 400 capacity 400 or less capacity	Semi Annual Annual	One Year One Year	note a $40
A-4	Assembly	Churches, low density, recreation & similar uses	Prior to issuance of each new certificate	Five Years	$40
A-5	Assembly	Stadiums, bleachers, places of outdoor assembly	Prior to issuance of each new certificate	One Year	note b
"A"	Special Amusement Buildings or portions thereof (780 CMR 413.0)	Special Amusement Buildings or portions thereof (780 CMR 413.7)	Annually prior to issuance of a new certification	One Year	As established by the city or town in accordance with 780 CMR 106.5
E	Educational	Educational	Prior to issuance of each new certificate	One Year	$40
E	Day Care	Child day care centers (see Chapter 4)	Prior to issuance of each new certificate	One Year	$40
I-2	Institutional	Incapacitated - hospitals, nursing homes, mental hospitals, certain day care facilities (see Chapter 4)	Prior to issuance of each new certificate	Two Years	note d
I-3	Institutional	Restrained - prisons, jails, detention centers, etc.	Prior to issuance of each new certificate	Two Years	note c
R-1	Residential	Hotels, motels, lodging houses, dormitories, etc. (note g)	Prior to issuance of each new certificate	One Year	note e
R-2	Residential	Multi family (note g)	Prior to issuance of each new certificate	Five Years	note f
R-1	Residential Special Occupancy	Detoxification facilities (see Chapter 4)	Prior to issuance of each new certificate	Two Years	$75
R-2	Residential Special Occupancy	Summer camps for children (see chapter 4)	Annual	One Year	note h
R-3 or R-4	Residential Special Occupancy	Group Residence (see Chapter 4)	Annual	One Year	note h
R-5	Residential Special Occupancy	Limited Group Residence (see Chapter 4)	Annual	One Year	note h

Notes applicable to Table 106

General: The maximum certification period specified in Table 106 is intended to provide administrative flexibility. For those *buildings* and *structures* or parts thereof allowing more than one year maximum certification period, the building official may determine the length of validity of the certificate issued. For example, a building in the R-2 use group could be issued a certificate valid for one, two, three, four or five years. The total amount of fees charged for a certificate or certificates issued during the maximum certification period can exceed the fee listed or referenced in column 4 of Table 106. For example, if the building official issues a certificate valid for two years for a building in the R-2 use group, the fee charged would be 2/5 times the fee per maximum certification period as determined for the building in question using the formula in **Note f.**

Note a. For *buildings* or *structures*, or parts thereof, in the A-3 Use Group categories, with capacities over 400, the fee to be charged for the maximum certification period of one year is $75 for accommodations for up to 5,000 persons, plus $15 for the accommodations for each additional 1,000 persons or fraction thereof.

Note b. For all *buildings* or *structures*, or parts thereof, in A-5 use group, the fee to be charged for the maximum certification period of one year is $40 for seating accommodations for up to 5,000 persons, plus $8 for the accommodation for each additional 1,000 persons or fraction thereof.

Note c. For all *buildings* and *structures*, or parts thereof, in the I-3 use group, the fee to be charged for the maximum certification period of two years is $75 for each *structure* containing up to 100 beds, plus a $2 charge for each additional ten beds or fraction thereof over the initial 100 beds.

Note d. For hospitals, nursing homes, sanitariums, and orphanages in the I-2 use group, the fee to be charged for the maximum certification period of two years is $75 for each *structure* containing up to 100 beds, plus a $2 charge for each additional ten beds or fraction thereof over the initial 100 beds. All other *buildings* or *structures* or parts thereof in the I-2 use group classification shall be charged a fee of $75 for a two year maximum certification period.

Note e. For all *buildings* and *structures* or parts thereof in the R-1 use group, the fee to be charged for the maximum certification period of one year shall be $40 for up to five units plus $2 per unit for all over five units. A unit shall be defined as follows:

two hotel guest rooms;
two lodging house guest rooms;
two boarding house guest rooms; or
four dormitory beds

Note f. For all *buildings* and *structures* or parts thereof in the R-2 use group, the fee to be charged for the maximum certification period of five years shall be $75, plus $2 per dwelling unit except that three family dwelling units shall be exempt from such fees.

Note g. For purposes of determining the required number of inspections, the maximum certification period, and the fees, as specified in Table 106, dormitories are included in the R-1 use group classification rather than the R-2.

Note h. Summer camps for children in use group R-2 shall be inspected and certified annually prior to the beginning of each season. The annual fee shall be $15 for the first 25 residential units: $8 for each additional 25 residential units; and $15 for each assembly building or use. (A residential unit for this purpose shall be defined as four beds).

106.6 Reports by the Building Official

106.6.1 Report to Appointing Authority: The building official shall submit to the appointing authority of the jurisdiction a written report of operations in a form and content and at intervals as shall be prescribed by the appointing authority.

106.6.2 Report to assessors: Pursuant to M.G.L. c. 143, § 61, the building official shall give to the assessors of the municipality written notice of the granting of permits for the construction of any *buildings* or *structures*, or for the removal or demolition, or for any substantial alteration or addition thereto. Such notice shall be given within seven days after the granting of each permit, and shall state the name of the person to whom the permit was granted and the location of the *building* or *structure* to be constructed, reconstructed, altered, demolished or removed.

106.6.3 Report to Local United States Postmaster: Pursuant to M.G.L. c. 143, § 3X the building official shall notify the local United States Postmaster of the issuance of a building permit authorizing the construction of any *building* containing ten or more residential units.

106.7 Department records: The building official shall maintain official records of applications received, permits and certificates issued, inspections performed fees collected, reports of inspections, and notices and orders issued. Such records shall be retained in the official records as long as the *building* or *structure* to which they relate remains in existence unless otherwise provided for by law.

780 CMR 107.0 DUTIES AND POWERS OF THE STATE INSPECTOR
(M.G.L. c. 143, § 3A)

107.1 The State Inspector: In every city and town 780 CMR shall be enforced by the State Inspector of the Department of Public Safety, Division of Inspections, as to any *structures* or *buildings* or parts thereof that are owned by the Commonwealth or any departments, commissions, agencies, or authorities of the Commonwealth. The state inspector shall have as to such *buildings* and *structures* all the powers of a building commissioner or inspector of buildings. All *buildings* and *structures* owned by any authority established by the legislature and not owned by the Commonwealth shall be regulated in accordance with 780 CMR 106.0.

107.2 Other responsibilities: The state inspector shall make periodic reviews of all local building inspection practices, provide technical assistance and advice to the local building officials in the implementation of 780 CMR, and report in writing his findings to the building officials.

107.3 Review by the Commissioner of Public Safety: The Commissioner of the Commonwealth of Massachusetts, Department of Public Safety shall establish districts which shall be supervised by a state inspector of the Division of Inspections. The Commissioner may review, on his own initiative, or on the application of any state inspector, any action or refusal or failure of action by any building official the result of which does not comply with the uniform implementation of 780 CMR; and may reverse, modify or annul, in whole or in part, such action except with respect to the specialized codes, provided that an order or action of the Commissioner shall not reverse, modify, annul, or contravene any order, action, determination, interpretation or any decision by the BBRS or the State Building Code Appeals Board.

107.4 Reports: The state inspector shall file with the BBRS reports of his periodic reviews and recommendations for improvements of building inspection practices. The format and due dates for these reports shall be determined by the BBRS.

780 CMR 108.0 RULES AND REGULATIONS

108.1 Rule making authority: Under authority granted by St. 1984, c. 348, as amended, the BBRS is empowered in the interest of public safety, health and general welfare, to adopt and promulgate rules and regulations, and to interpret and implement the provisions of 780 CMR to secure the intent thereof.

108.2 Amendments and promulgation of rules: In accordance with the provisions of M.G.L. c. 143, § 97, any person may propose amendments to 780 CMR. Public hearings shall be held in the city of Boston in May and November of each year, and at such other times and places as the BBRS may determine, to consider petitions for such amendments. Amendments adopted by the BBRS shall be binding and have the full force and effect in all cities and towns.

108.3 Activities requiring licenses, registration or certification:

108.3.1 Testing laboratories: A testing laboratory, branch laboratory and/or project laboratory shall not test *concrete* and/or concrete materials for use in *structures* subject to construction control (780 CMR 116.0) and/or controlled materials (780 CMR 17) unless licensed by the BBRS in accordance with 780 CMR and 780 CMR R1: the Rules and Regulations for Licensing of Concrete Testing Laboratories.

108.3.2 Field technicians: A person shall not engage in the activities of field testing of *concrete* for use in *structures* subject to construction control (780 CMR 116.0) and/or controlled materials (780 CMR 17) unless such person is licensed by the BBRS in accordance with 780 CMR R2: the Rules and Regulations for Concrete Testing Personnel.

108.3.3 Manufactured buildings: No individual, organization or firm shall be engaged in the construction of *manufactured buildings* for use in the Commonwealth of Massachusetts unless approved to construct same by the BBRS in accordance with 780 CMR R3.

108.3.4 Native Lumber: No individual, organization or firm shall engage in the production of native lumber for use in *structures* within the Commonwealth of Massachusetts unless registered by the BBRS in accordance with 780 CMR and 780 CMR R4: the Rules and Regulations Controlling the Use of Native Lumber.

108.3.5 Licensing of Construction Supervisors:

108.3.5.1 Except for those *structures* governed by Construction Control in 780 CMR 116.0, effective July 1, 1982, no individual shall be engaged in directly supervising persons engaged in construction, reconstruction, alteration, repair, removal or demolition involving any activity regulated by any provision of 780 CMR, unless said individual is licensed in accordance the Rules and Regulations for Licensing Construction Supervisors as set forth in 780 CMR R5.

No person shall be engaged in the supervision of the field erection of a *manufactured building* unless such person is licensed in accordance with 780 CMR R5: The Rules and Regulations for the Licensing of Construction Supervisors.

Exception: Any Home Owner performing work for which a building permit is required shall be exempt from the licensing provisions of 780 CMR 108.3.5; provided that if a Home Owner engages a person(s) for hire to do such work, that such Home Owner shall act as supervisor. This exception shall not apply to the field erection of a manufactured buildings constructed pursuant to 780 CMR 35 and 780 CMR R3. For the purposes of 780 CMR 108.3.5, a "Homeowner" is defined as follows: Person(s) who owns a parcel of land on which he/she resides or intends to reside, on which there is, or is intended to be, a *one or two family dwelling*, attached or detached structures accessory to such use and/or farm structures. A person who constructs more than one home in a two-year period shall not be considered a home owner.

Note f. The permitted quantities shall not be limited in a building equipped throughout with an automatic sprinkler system in accordance with 780 CMR 906.2.1.

Note g. A dust explosion potential is considered to exist where 1 pound or more of combustible dust per 1,000 cubic feet of volume is normally in suspension or could be put into suspension in all or a portion of an enclosure or inside pieces of equipment. This also includes combustible dust which accumulates on horizontal surface inside buildings or equipment and which could be put into suspension be an accident, sudden force or sudden explosion.

Note h. Permitted only in buildings equipped throughout with an automatic sprinkler system in accordance with 780 CMR 906.2.1.

Note i. One pound of black sporting powder and 20 pounds of smokeless powder are permitted in sprinklered or unsprinklered buildings.

Note j. Containing not more than the exempt amounts of Class I-A, Class I-B or Class I-C flammable liquids.

Note k. Quantities in parenthesis indicate quantity units in parenthesis at the head of each column. 1 cubic foot = 0.028 m^3; 1 pound = 0.454 kg; 1 gallon = 0.00379 m^3

Table 307.8(2)
EXEMPT AMOUNTS OF HAZARDOUS MATERIALS, LIQUIDS AND CHEMICALS PRESENTING A HEALTH HAZARD
MAXIMUM QUANTITIES PER CONTROL AREA[a,b,h]

Material	Storage[c]			Closed systems[c]			Open systems[c]	
	Solid pounds[d,e]	Liquid gallons (pounds)[d,e]	Gas cubic feet	Solid pounds[d]	Liquid gallons (pounds)[d]	Gas cubic feet	Solid pounds[d]	Liquid gallons (pounds)[d]
Corrosive	5,000	500	810[d,e]	5,000	500	810[d,e]	1,000	100
Highly toxic	1	(1)	20[f]	1	(1)	20[f]	¼	(¼)
Irritant	5,000	500	810[d,e]	5,000	500	810[d,e]	1,000	100
Radioactive[g]	25 rem - unsealed source 100 rem - sealed source			100 rem - sealed source			25 rem - sealed source	
Sensitizer	5,000	500	810[d,e]	5,000	500	810[d,e]	1,000	100
Toxic	500	(500)	810[d,e]	500	(500)	810[d,e]	125	(125)
Other health hazards	5,000	500	810[d,e]	5,000	500	810[d,e]	1,000	100

Note a. For use of control areas, see 780 CMR 417.2

Note b. In retail sales occupancies, the quantities of medicines, foodstuffs and cosmetics, containing not more than 50% by volume of water-miscible liquids and with the remainder of the solutions not being flammable, shall not be limited provided that such materials are packaged in individual containers not exceeding 1 gallon.

Note c. The aggregate quantity in utilization and storage shall not exceed the quantity listed for storage.

Note d. Maximum quantities shall be increased 100% in buildings equipped throughout with an automatic sprinkler system in accordance with 780 CMR 906.2.1. Where note e. also applies, the increase for both notes shall be applied accumulatively.

Note e. Maximum quantities shall be increased 100% when stored in approved storage cabinets, gas cabinets, fume hoods, exhausted enclosures, or safety cans as specified in the fire prevention code listed in *Appendix A*. Where note d. also applies, the increase for both notes shall be applies accumulatively.

Note f. Permitted only when stored in approved exhausted gas cabinets, exhausted enclosures or fume hoods.

Note g. Maximum dosage permitted in any single exposure.

Note h. Quantities in parenthesis indicate quantity units in parenthesis at the head of each column. 1 cubic foot = 0.028 m^3; 1 pound = 0.454 kg; 1 gallon = 0.00379 m^3

308.4.4 Occupancy Condition IV: This occupancy condition shall include all buildings in which free movement is restricted from an occupied space. Remote-controlled release is provided to permit movement from all sleeping rooms, activity spaces and other occupied areas within the *smoke compartment* to other *smoke compartments*.

308.4.5 Occupancy Condition V: This occupancy condition shall include all buildings in which free movement is restricted from an occupied space. Staff-controlled release is provided to permit movement from all sleeping rooms, activity spaces and other occupied areas within the *smoke compartment* to other *smoke compartments*.

780 CMR 309.0 MERCANTILE USE GROUP

309.1 General: All buildings and structures which are occupied for display and sales purposes involving stocks of goods, wares or merchandise incidental to such purposes and open to the public, shall be classified as Use Group M. This includes, among others, retail stores, automotive service stations, shops, salesrooms and markets. An automotive service station is that portion of a property where motor fuels are stored and dispensed from fixed equipment into the fuel tanks of motor vehicles or approved containers, including any building used for the sale of automotive accessories, or for minor automotive repair work. Minor repairs include the exchange of parts, oil changes, engine tune-ups and similar routine maintenance work. Retail sales of *hazardous materials* shall comply with 780 CMR 307.8 ***or 780 CMR 426, as applicable.***

780 CMR 310.0 RESIDENTIAL USE GROUPS

310.1 General: All structures in which individuals live, or in which sleeping accommodations are provided (with or without dining facilities), excluding those that are classified as institutional occupancies, shall be classified as Use Group R-1, R-2, R-3, R-4 or ***R-5***. The term "Use Group R" shall include Use Groups R-1, R-2 and R-3, R-4 and R-5.

> ***Note: Assisted Living Residences which are certified as such by the Executive Office of Elder Affairs pursuant to M.G.L. c. 19D shall be classified in the residential use group R-1, R-2, R-3 or R-4 as applicable. Portions of an assisted Living Residence which are used for any use other than residential shall be classified in accordance with the intended use.***

310.2 Definitions: The following words and terms shall, for the purposes of 780 CMR 3 and as used elsewhere in 780 CMR, have the meanings shown herein.

Dwellings:

Assisted Living Residence: A residence licensed by the Executive Office of Elder Affairs pursuant to M.G.L. c. 19D.

Boarding house: A building arranged or used for lodging for compensation, with or without meals, and not occupied as a single unit.

Dormitory: A space in a building where group sleeping accommodations are provided in one room, or in a series of closely associated rooms.

Dwelling unit: A single unit providing complete, independent living facilities for one or more persons, including permanent provisions for living, sleeping, eating, cooking and sanitation.

Hotel: Any building containing six or more guest rooms, intended or designed to be used, or which are used, rented or hired out to be occupied or which are occupied for sleeping purposes by guests.

Lodging house: Refer to M.G.L. c. 140, § 22

Motel: A hotel as defined in 780 CMR.

Multiple dwelling: A building or portion thereof containing more than two *dwelling units* and not meeting the requirements for a *multiple single dwelling*.

Multiple single dwelling: A building or portion thereof containing more than two *dwelling units* (see 780 CMR 310.5)

One-family dwelling: A building containing one *dwelling unit* but not a *lodging house* (see M.G.L. c. 140, § 22).

Two-family dwelling: A building containing two *dwelling units* but not *lodging house* (see M.G.L. c. 140, § 22).

310.3 Use Group R-1 structures: This use group shall include all *hotels, motels, boarding houses* and similar buildings arranged for shelter and sleeping accommodations and in which the occupants are primarily transient in nature, occupying the facilities for a period of less than 30 days.

310.4 Use Group R-2 structures: This use group shall include all *multiple dwellings* having more than two *dwelling units*, except as provided for in 780 CMR 310.5 for multiple *single dwelling units*, and shall also include all *boarding houses* and similar buildings arranged for shelter and sleeping accommodations in which the occupants are primarily not transient in nature.

310.4.1 Dormitories: A *dormitory* facility which accommodates more than five persons more than 2½ years of age shall be classified as Use Group R-2.

310.5 Use Group R-3 structures: This use group shall include all buildings arranged for occupancy as *one- or two-family dwellings*, including *multiple single family dwellings* where each unit has two independent *means of egress* not common to any other *dwelling unit*, and where each *dwelling unit* is separated from adjoining dwelling units by two-hour *fire separation assemblies* (see 780 CMR 709.0). Use group R-3 structures are not *lodging houses* (see M.G.L. c. 140, § 22).

Exceptions

1. In *multiple single-family dwellings* that are equipped throughout with an approved *automatic sprinkler system* installed in accordance with 780 CMR 906.2.1 or 906.2.2, the fireresistance rating of the *dwelling unit* separation shall not be less than one hour. *Dwelling unit* separation walls shall be constructed as *fire partitions* (see 780 CMR 711.0).
2. In multiple *single-family dwellings* that are equipped throughout with an approved *automatic sprinkler system* installed in accordance with 780 CMR 906.2.3, a two-hour *fire separation assembly* shall be provided between each pair of *dwelling units*. The fireresistance rating between each *dwelling unit* shall not be less than one hour and shall be constructed as a *fire partition*.

310.5.1*Family day-care home: A family day-care home as defined by M.G.L. c.28A, §. 9, shall be classified as use group R-3 or R-4. Such facility shall not accommodate more than six children.*

area of the *stage* shall be located near the center and above the highest part of the *stage* area, except as otherwise provided for in 780 CMR 412.3.9. Supplemental means shall be provided for manual operation of the ventilator. Curbs shall be provided as required for skylights in 780 CMR 2608.2.

412.3.8.2 Smoke control: Smoke control in accordance with 780 CMR 921.0 shall be provided to maintain the smoke layer interface not less than six feet (1829 mm) above the highest level of the assembly seating or above the top of the proscenium opening where a proscenium wall is required by 780 CMR 412.3.5.

412.3.9 Superimposed theaters: Additions or extensions shall not be erected over the *stage* section of a theater, nor shall a second theater be erected above another. Where approved, the prohibition against superimposed theaters and construction above the *stage* shall not apply where approved access is provided for fire fighting with direct means of *ventilation* to the outer air from the *stage* portion.

412.4 Platforms: *Platform* construction shall comply with 780 CMR 412.4.1 and 412.4.2.

412.4.1 Materials: In buildings required to be of Type 1 or Type 2 construction where the *platforms* are not more than 30 inches (762 mm) above the main floor level, the minimum type of construction for a permanent *platform* shall be Type 2C. For all types of construction where the *platforms* are not more than 30 inches (762 mm) above the main floor level, not larger in area than 10% of the room floor area and not more than 200 square feet (19 m2) in area, the minimum type of construction for a permanent *platform* shall be Type 5B. For all types of construction where the *platforms* are not more than 30 inches (762 mm) above the main floor level, not larger than ⅓ of the room floor area and not more than 3,000 square feet (279 m^2) in area, the minimum type of construction for a permanent *platform* shall be Type 4 or the *platform* shall be constructed of fireretardant-treated wood. All other permanent *platforms* shall be constructed of approved materials as required for floors for the required type of construction of the building in which it is located. Temporary *platforms* shall be constructed of any approved material.

412.4.2 Space beneath: The space between the floor and a temporary *platform* above shall not be utilized for any purpose other than electrical wiring to *platform* equipment. Where the space between the floor and a permanent *platform* above is utilized for any purpose other than electrical wiring or plumbing, the *platform* shall provide a one-hour fireresistance rating.

412.5 Dressing and appurtenant rooms: Dressing and appurtenant rooms shall comply with 780 CMR 412.5.1 through 412.5.3.

412.5.1 Construction: Dressing rooms, scene docks, property rooms, workshops, storerooms and all compartments appurtenant to the *stage* shall be separated from each other and from the stage and all other parts of the building by *fire separation assemblies* with not less than a one-hour fireresistance rating with approved opening protectives. Such rooms shall not be placed immediately over or under the operating *stage* area.

Exception: Separation from the *stage* is not required for *stages* having a floor area of 500 square feet (46.5 m^2) or less.

412.5.2 Opening protectives: Openings other than to trunk rooms and the necessary doorways at *stage* level shall not connect such rooms with the *stage*, and such openings shall be protected with *fire doors* that comply with 780 CMR 716.0.

412.5.3 Dressing room and stage exits: Each tier of dressing rooms shall be provided with at least two *means of egress*. *Means of egress* stairways from dressing and storage rooms are not required to be enclosed where located in the *stage* area behind the proscenium wall. At least one approved *means of egress* shall be provided from each side of the *stage*; from each side of the space under the *stage*; from each fly gallery; and from the gridiron. A steel ladder shall be provided from the gridiron to a scuttle in the *stage* roof.

412.6 Automatic sprinkler system: *Stages* and enclosed *platforms* shall be equipped with an *automatic sprinkler system* in accordance with 780 CMR 412.0 and 780 CMR 906.0 or 780 CMR 907.0. The system shall be installed: under the roof and gridiron, in the tie and fly galleries and in all places behind the proscenium wall of the *stage*; over and within enclosed platforms in excess of 500 square feet (46.5 m^2) in area; and in dressing rooms, lounges, workshops and storerooms accessory to such *stages* or enclosed *platforms*.

Exceptions:

1. *Stages* or enclosed *platforms* open to the auditorium room on three or more sides.
2. Altars, pulpits or similar *platforms* and accessory rooms.
3. *Stage* gridirons where sidewall *sprinklers* with 135°F (57°C) rated heads with heat-baffle plates are installed around the perimeter of the *stage* except for the proscenium opening at points not more than 30 inches (762 mm) below the gridiron nor more than six inches (152 mm) below the baffle plate.
4. Under *stage* or enclosed *platform* areas less than four feet (1219 mm) in clear height utilized

for storage, the *stage* and supporting structures shall be of one-hour fireresistance rated construction.

412.7 Standpipes: A wet *standpipe system* in accordance with 780 CMR 914.0 shall be provided and equipped with 1½-inch hose connections on each side of the *stage*.

> **Exception**: Where the building or area is equipped throughout with an *automatic sprinkler system*, the hose connections that are supplied from the *automatic sprinkler system* shall have a *water supply* of not less than that required by NFiPA 13 listed in ***Appendix A***.

412.7.1 Hose and cabinet: The hose connections shall be equipped with sufficient lengths of 1½ -inch hose to provide fire protection for the *stage* area; such connections shall be equipped with an approved adjustable fog nozzle and be mounted in a cabinet or a rack.

780 CMR 413.0 SPECIAL AMUSEMENT BUILDINGS

413.1 General: Special amusement buildings shall comply with the requirements for buildings of the appropriate assembly use group in addition to the requirements of 780 CMR 413.0.

> **Exception**: Buildings or portions thereof that are essentially open to the outside air, such as buildings without walls or without a roof and arranged to prevent the accumulation of smoke in the building or structure are not required to comply with 780 CMR 413.0.

413.2 Special amusement building: A special amusement building is any temporary, permanent or mobile building or portion thereof which is occupied for amusement, entertainment or educational purposes and which contains a device or system which conveys passengers or provides a walkway along, around or over a course in any direction so arranged that the *means of egress* path is not readily apparent due to visual or audio distractions or is intentionally confounded or is not readily available due to the nature of the attraction or mode of conveyance through the building or structure.

413.3 Fire detection: All special amusement buildings shall be equipped with an automatic fire detection system in accordance with 780 CMR 918.0.

> **Exception**: In areas where the ambient conditions will cause a smoke detector to activate, an approved alternative type of automatic detector shall be installed.

413.4 Automatic sprinklers: All special amusement buildings shall be equipped throughout with an *automatic sprinkler system* in accordance with 780 CMR 906.0. Where the special amusement building is temporary or mobile, the *sprinkler water supply* shall be of an approved temporary means.

> **Exception**: An *automatic sprinkler system* is not required where the total floor area of a temporary special amusement building is less than 1,000 square feet (93 m^2) and the travel distance from any point to an *exit* is less than 50 feet (15240 mm).

413.5 System response: The activation of the automatic fire detection system within a single protected area or the *automatic sprinkler system* shall automatically:

1. Cause illumination of the *means of egress* with light of not less than one footcandle (10.76 lux) at the walking surface level;
2. Stop any conflicting or confusing sounds and visual distractions; and
3. Activate an approved directional *exit* marking that will become apparent in an emergency.

413.5.1 Alarm: Activation of any single smoke detector, the *automatic sprinkler system* or any other automatic fire detection device shall immediately sound an alarm at the building at a constantly attended location from which emergency action can be initiated including the capability of manual initiation of requirements in 780 CMR 413.5.

413.5.2 Public address system: A public address system, which is also permitted to serve as an alarm system, shall be provided and shall be audible throughout the entire special amusement building.

413.5.3 Exit marking: "Exit" signs shall be installed at required *exit* doorways. Approved directional exit markings shall also be provided and shall include signs as required by 780 CMR 1023.0. Where mirrors, mazes or other designs are used that confound the *means of egress* paths, approved low-level "exit" signs and directional path markings shall be provided and located not more than eight inches (203 mm) above the walking surface and on or near the *means of egress* path. Such markings shall become visible when activated in accordance with 780 CMR 413.5, item 3.

413.6 Interior finish: The interior finish shall be Class I in accordance with 780 CMR 803.2.

413.7 Required inspections. Buildings or portions thereof, classified as *special amusement buildings* shall be inspected on an annual basis to ensure compliance with the applicable portions of 780 CMR.

780 CMR 414.0 AIRPORT TRAFFIC CONTROL TOWERS

414.1 General: The provisions of 780 CMR 414.0 shall apply to airport traffic control towers not exceeding 1,500 square feet per floor occupied only for air traffic control, electrical and mechanical equipment rooms, radar and electronics rooms,

780 CMR 506.2 Allowable area increase due to street frontage.
780 CMR 506.3 Allowable area increase due to automatic fire suppression system installation.
780 CMR 506.4 Allowable area reduction for multi-story buildings.
780 CMR 507.0 Unlimited area one-story buildings.

Note b. Buildings of Type 1 construction permitted to be of unlimited tabular heights and areas are not subject to special requirements that allow increased heights and areas for other types of construction (see 780 CMR 503.1.4).

Note c. For height exceptions for auditoriums in occupancies in Use Groups A-4 and E, see 780 CMR 504.3.

Note d. For height exceptions for day care centers in buildings of Type 5 construction, see 780 CMR 504.4.

Note e. For exceptions to height and area limitations of buildings for Use Group H, see 780 CMR 4 governing the specific use groups.

Note f. For exceptions to height of buildings for Use Group R-2 of Types 2B and 3A construction, see 780 CMR 504.6 and 504.7.

Note g. For height and area exceptions for open parking structures, see 780 CMR 406.0.

Note h. For exceptions to height and area limitations for special industrial occupancies, see 780 CMR 503.1.1.

Note i. Occupancies in Use Groups H-1 and H-2 shall not be permitted below grade.

Note j. Rooms and areas of Use group H-2 containing pyrophoric materials shall not be permitted in buildings of Type 3, 4, or 5 construction.

Note k. Occupancies in Use Group H-1 are required to be detached one-story buildings (see 780 CMR 707.1.1).

Note l. For exceptions to height for buildings with occupancies in Use Group H, see 780 CMR 504.5

Note m. ***Hospitals, other than college or school infirmaries, shall be constructed of Type 1-B or higher construction.***

Note n. 1 foot = 304.8 mm; 1 square foot = 0.093 m^2

503.1.4 Type 1 construction: Buildings of Type 1 construction which are permitted to be of unlimited tabular *heights* and *areas* by Table 503, are not subject to the special requirements that allow increased *heights* and *areas* for other types of construction.

503.2 Area limitations: The *area* limitations specified in Table 503 shall apply to the maximum horizontally projected area of all buildings fronting on a street or a public space not less than 30 feet (9144 mm) in width with access from a public street.

503.3 Height limitations: The *height* in feet and the number of *stories above grade* specified in Table 503 shall apply to all buildings and to all separate parts of a building that are enclosed within *fire walls* complying with the provisions of 780 CMR 7. A *basement* shall be considered as a *story above grade* where the finished surface of the floor above the *basement* is more than six feet (1829 mm) above *grade plane*; or more than six feet (1829 mm) above the finished ground level for more than 50% of the total building perimeter; or more than 12 feet (3658 mm) above the finished ground level at any point.

780 CMR 504.0 HEIGHT MODIFICATIONS

504.1 General: The provisions of 780 CMR 504.0 shall modify the *height* limitations of Table 503 as herein specified.

504.2 Automatic sprinkler systems: Where a building is equipped throughout with an automatic sprinkler system in accordance with 780 CMR 906.2.1, the building height limitation specified in Table 503 shall be increased one story and 20 feet (6096 mm). This increase shall not apply to buildings of Types 2C, 3A, 4 and 5A construction with an occupancy in Use Group I-2, or to buildings with an occupancy in Use Group H-1, H-2 or H-3. The building height limitations for buildings with an occupancy in Use Group R specified in Table 503 shall be increased one story and 20 feet (6096mm) where the building is equipped throughout with an automatic sprinkler system installed in accordance with 780 CMR 906.2.2 and the system is supervised in accordance with 780 CMR 923.1, method 1, 2 or 3, but not to exceed a height of four stories or 60 feet (18288 mm).

504.3 Auditoriums: The maximum *height* of auditoriums in Use Groups A-4 and E shall be 65 feet (19812 mm) in buildings of Type 2B, 3A, 4 or 5A construction and 45 feet (13716 mm) in buildings of Type 2C, 3B or 5B construction.

504.4 Day care centers: The *height* limitations of Table 503 for day care centers classified as Use Group E, in buildings of Type 5 construction, shall be increased one story and 20 feet (6096 mm) provided that the total occupant load is less than 50 persons.

504.5 High-hazard use groups: Buildings and structures with an occupancy in Use Group H that requires unusual *heights* necessary to accommodate special manufacturing processes and equipment shall be exempt from the tabular *height* limitations, in feet, of Table 503.

504.6 Type 3A construction: The *height* limitation for buildings of Type 3A construction with occupancies in Use Group R-2 shall be increased to six stories and 75 feet (22860 mm) where the first floor above the *basement* has a fireresistance rating of not less than three hours and the floor *area* is subdivided by two-hour fireresistance rated *fire walls* into *fire areas* of not more than 3,000 square feet (279 m²).

504.7 Type 2B construction: The *height* limitation for buildings of Type 2B construction with occupancies in Use Group R-2 shall be increased to nine stories and 100 feet (30480 mm) where the building is separated by not less than 50 feet (15240 mm) from any other building on the *lot* and from *interior lot lines*, the *exits* are segregated in a *fire area* enclosed by a two-hour fireresistance rated *fire wall* and the first floor construction has a fireresistance rating of not less than 1½ hours.

780 CMR 505.0 MEZZANINES

505.1 General: A *mezzanine* or mezzanines in compliance with 780 CMR 505.0 shall be considered a portion of the floor below. Such *mezzanines* shall not contribute to the *building area* as regulated by 780 CMR 503.2. Such *mezzanines* shall not contribute to the number of stories as regulated by 780 CMR 503.3. The area of the *mezzanine* shall be included in determining the *fire area*.

505.2 Area limitation: The aggregate area of a *mezzanine* or *mezzanines* within a room shall not exceed ⅓ of the area of that room. The enclosed portions of rooms shall not be included in a determination of the size of the room in which the *mezzanine* is located. In determining the allowable *mezzanine* area, the area of the *mezzanine* shall not be included in the area of the room.

Exception: The aggregate area of *mezzanines* in buildings and structures of Type 1 or 2 construction for special industrial occupancies in accordance with 780 CMR 503.1.1 shall not exceed ⅔ of the area of that room.

505.3 Egress: Each occupant of a *mezzanine* shall have access to at least two independent *means of egress* where such spaces require two *means of egress* in accordance with 780 CMR 1017.2. Where a *stairway* provides a means of *exit access* from a *mezzanine*, the maximum travel distance required by 780 CMR 1017.2 shall be measured to the bottom of the *stairway*.

505.4 Openness: A *mezzanine* shall be open and unobstructed to the room in which such *mezzanine* is located except for walls not more than 42 inches (1067 mm) high, columns and posts.

Exceptions

1. *Mezzanines* or portions thereof are not required to be open to the room in which the *mezzanines* are located, provided that the occupant load of the aggregate area of the enclosed space does not exceed ten.
2. A *mezzanine* having two or more *means of egress* is not required to be open to the room in which the *mezzanine* is located, if at least one of the *means of egress* provides direct access to an *exit* from the *mezzanine* level.

780 CMR 506.0 AREA MODIFICATIONS

506.1 General: The provisions of 780 CMR 506.0 shall modify the *area* limitations of Table 503 as herein specified.

506.2 Street frontage increase: Where a building or structure has more than 25% of the building perimeter fronting on a street or other unoccupied space, the *area* limitations specified in Table 503 shall be increased 2% for each 1% of such excess frontage. The unoccupied space shall be on the same *lot* or dedicated for public use, shall not be less than 30 feet (9144 mm) in width and shall have access from a street by a posted fire lane not less than 18 feet (5486 mm) in width.

506.3 Automatic sprinkler system: Where a building, other than those with an occupancy in Use Group H-1, H-2 or H-3, is equipped throughout with an *automatic sprinkler system* installed in accordance with 780 CMR 906.2.1, the *area* limitation specified in Table 503 shall be increased 200% for one-and two-story buildings and 100% for buildings more than two stories in *height*.

506.4 Multistory buildings: The *area* limitations for buildings two stories in *height* shall be the same as the area limitations provided in Table 503 for one-story buildings. In buildings over two stories in *height*, the *area* limitations of Table 503 for one-story buildings shall be reduced as specified in Table 506.4.

Table 707.1
FIRE AND PARTY WALL FIRERESISTANCE RATINGS

Use Group[a]	Minimum Fireresistance rating (hours)
A-3, A-4, A-5, B, E, F-2, H-4, I-1, I-2, R, S-2	2
A-1, A-2, F-1, H-3, I-3, M, S-1	3
H-2	4

Note a. For requirements for Use Group H-1, see 780 CMR 707.1.1.

707.1.1 Use Group H-1: Occupancies in Use Group H-1 shall not be located in a building that: is more than one story in *height*, has a *basement*; or is attached to another building. An occupancy in any use group other than H-1 shall not be located in a building with an occupancy in Use Group H-1.

Exception: The story *above grade*, where provided with barricaded construction in accordance with the fire prevention code listed in *Appendix A*, shall not be considered a *basement*.

707.2 Cutting walls: A wall that is eight inches or less in thickness shall not be cut for chases or socketed for insertion of structural members subsequent to erection (see 780 CMR 2109.1.1).

707.3 Hollow walls: The wall shall not be less than the minimum thickness specified in ACI 530/ASCE 5/TMS 402 listed in *Appendix A*.

707.4 Combustible insulation: The code official shall permit the application of cork, fiberboard or other combustible insulation where laid up without intervening air spaces and attached directly to the face of the wall, and where protected on the exposed surface as provided for in 780 CMR 722.0 and 2309.1.

707.5 Continuity of walls: In all buildings or structures, walls shall be continuous from foundation to two feet eight inches (813 mm) above the roof surface, except as provided for in 780 CMR 707.5.1 through 707.5.3. *Fire walls* shall be made smoke tight at their junction with exterior walls. In exterior wall construction employing studs, the wall shall extend through the stud space to the exterior sheathing.

707.5.1 Noncombustible roofs: The wall is permitted to terminate at the underside of the roof deck where the roof is of approved noncombustible construction and is properly *firestopped* at the wall.

707.5.2 Combustible roofs: The wall is permitted to terminate at the underside of the roof deck in Types 3, 4 and 5 construction where all of the following conditions are met:

1. The wall is properly *firestopped* at the deck.
2. The roof sheathing or deck is constructed of approved noncombustible materials or of fireretardant-treated wood, for a distance of four feet (1219 mm) on both sides of the wall, or such roof sheathing or deck is constructed with ⅝-inch Type X gypsum board supported directly beneath the underside of the roof sheathing or deck, using minimum two-inch ledgers attached to the sides of the roof framing members, for a minimum distance of four feet (1219 mm) on both sides of the *fire wall*.
3. Combustible material does not extend through the wall.
4. The roof covering has a minimum of a Class C rating.

707.5.3 Noncombustible frame: The wall shall not be supported on the structural frame in buildings of noncombustible construction unless such supporting frame and all members, which under fire conditions provide lateral support for the frame, have a fire resistance at least equal to that required for the wall.

707.6 Offset fire walls: Where *fire walls* are offset at intermediate floor levels in protected skeleton-frame construction, the offset floor construction and the intermediate wall supports shall be constructed of approved noncombustible materials with a fireresistance rating not less than that required for the *fire wall*.

707.7 Penetrations: Penetrations through fire walls shall meet the limitations specified in 780 CMR 707.7.1 through 707.7.4.

707.7.1 Combustible framing: In addition to the provisions of 780 CMR 2305.6, adjacent combustible members entering into a masonry *fire wall* from opposite sides shall not have less than a four-inch (102 mm) distance between embedded ends. Where combustible members frame into hollow walls or walls of hollow units, all hollow spaces shall be solidly filled for the full thickness of the wall and for a distance not less than four inches (102 mm) above, below and between the structural members, with noncombustible materials approved for *firestopping* in accordance with 780 CMR 720.0.

707.7.2 Noncombustible penetrations: Cables and wires without combustible jackets or insulation, and noncombustible pipes, tubes, conduits and vents which penetrate a *fire wall* shall be tested in accordance with ASTM E119 listed in *Appendix A* as part of a rated assembly, or shall be protected by an approved *through-penetration protection system* that has been tested in accordance with ASTM E814 listed in *Appendix A*, or the annular space around the penetrating item shall be protected in accordance with 780 CMR 707.8.

The *through-penetration protection system* shall be tested in accordance with ASTM E814 listed in ***Appendix A***, with a minimum positive pressure differential of 0.01 inch of water column (2.5 P) and shall have an "F" rating of not less than the required rating of the wall penetrated.

707.7.3 Combustible penetrations: Cables and wires with combustible jackets or insulation, and combustible pipes, tubes and conduits which penetrate a *fire wall* shall be tested in accordance with ASTM E119 listed in ***Appendix A*** as part of a fireresistance rated assembly or shall be protected by an, approved *through-penetration protection* system that has been tested in accordance with ASTM E814 listed in ***Appendix A***.

The *through-penetration protection system* shall be tested in accordance with ASTM E814 listed in ***Appendix A***, with a minimum positive pressure differential of 0.01 inch of water column (2.5 P) and shall have an "F" rating of not less than the required rating of the assembly penetrated.

707.7.4 Electrical outlet boxes: Openings for steel electrical outlet boxes that do not exceed 16 square inches (10323 mm^2) in area are permitted provided that the area of such openings does not exceed 100 square inches (64516 mm^2) for any 100 square feet (9.3 m^2) of wall area. Outlet boxes on opposite sides of the wall shall be separated by a horizontal distance of not less than 24 inches (610 mm).

Exception: Openings for electrical outlet boxes of any material are permitted provided that such boxes are tested for use in fireresistance rated assemblies and installed in accordance with the tested assembly.

707.8 Annular space protection: Where permitted by 780 CMR 707.7.2 for noncombustible penetrating items, the annular space between the penetrating item and the fireresistance rated assembly being penetrated shall be protected as specified in 780 CMR 707.8.1 and 707.8.2.

707.8.1 Material: The material used to fill the annular space shall comply with 780 CMR 707.8.1.1 or 707.8.1.2.

707.8.1.1 Concrete or masonry assemblies: Penetrations of concrete or masonry assemblies by a maximum six-inch nominal diameter copper, iron or steel pipe, tube, conduit or wires and cables with steel jackets shall be permitted provided that the maximum opening size is 144 square inches (0.09 m^2) and the penetration is protected with concrete, grout or mortar for the full thickness of the assembly or the thickness required to provide a fireresistance rating equivalent to the required fireresistance rating of the assembly penetrated.

707.8.1.2 All assemblies: In all assemblies the material shall prevent the passage of flame and hot gases sufficient to ignite cotton waste when subjected to the time-temperature fire conditions of ASTM E119 listed in ***Appendix A***, under a minimum positive pressure differential of 0.01 inch of water column (2.5 P) at the location of the penetration for the time period equivalent to the required fireresistance rating of the assembly penetrated.

707.8.2 Sleeves: Where sleeves are installed, the sleeves shall be noncombustible and shall be securely fastened to the assembly penetrated. All space between the item contained in the sleeve and the sleeve itself, and any space between the sleeve and the assembly penetrated, shall be filled with a material that complies with 780 CMR 707.8.1.

780 CMR 708.0 FIRE WALL OPENINGS

708.1 General: Openings in *fire walls* shall not exceed the limitations in size and area herein prescribed.

708.2 Size of opening: Each opening through a *fire wall* shall not exceed 120 square feet (11.16 m^2). The aggregate width of all openings at any floor level shall not exceed 25% of the length of the wall.

Exception: Openings shall not be limited to 120 square feet (11.16 m^2) where both buildings are equipped throughout with an *automatic sprinkler system* installed in accordance with780 CMR 9.

708.2.1 First story: Where the entire first-story floor *areas* on both sides of a *fire wall* are equipped throughout with an approved *automatic sprinkler system* installed in accordance with 780 CMR 906.2.1, the maximum allowable size of openings on the first story of the building shall not exceed 240 square feet (22.32 m^2) with a minimum distance of three feet (914 mm) between adjacent openings.

708.3 Opening protectives: All opening protectives in *fire walls* shall comply with the provisions of 780 CMR 704.0 and shall have the minimum *fire protection rating* as set forth in 780 CMR 716.0.

780 CMR 709.0 FIRE SEPARATION ASSEMBLIES

709.1 General: *Fire separation assemblies* installed for purposes of the enclosure of *exits*, floor openings, *shafts*, areas of refuge and for subdividing purposes shall be constructed of approved materials consistent with the limitations for the building type of construction and shall have not less than the fireresistance rating prescribed by Table 602.

780 CMR 913.0 WET-CHEMICAL RANGE HOOD EXTINGUISHING SYSTEMS

913.1 General: Wet-chemical extinguishing systems shall be installed in accordance with the provisions of 780 CMR 913.0, and the BOCA Mechanical Code and NFiPA 17A listed in *Appendix A*. The system shall bear the *label* of an *approved agency* and shall be installed in accordance with the manufacturer's installation instructions. A wet-chemical system is a solution of water and potassium-car-bonate-based chemical, potassium-acetate-based chemical or a combination thereof which forms the extinguishing agent.

913.2 Design: The details of the system indicated on the *fire protection construction documents* shall include sufficient information and calculations on the amount of wet chemical; the size, length and arrangement of connected piping; and a description and location of nozzles so that the adequacy of the system can be determined. Information shall be submitted pertaining to the location and function of *detecting devices*, operating devices, auxiliary equipment and electrical circuitry, if used. Sufficient information shall be indicated to identify properly the apparatus and devices used. Any special features shall be adequately explained. (See 780 CMR 903.0.)

913.3 Actuation: Wet-chemical extinguishing systems shall be automatically actuated and shall be provided with a manual means of actuation.

913.4 Safety requirements: Where persons will be exposed to a wet-chemical discharge, warning signs and discharge alarms shall be provided.

913.5 Acceptance tests: All wet-chemical extinguishing systems shall be tested in accordance with NFiPA 17A listed in *Appendix A*. A completed system shall be tested by discharge of wet chemical in sufficient amounts to verify that the system is properly installed and functional. Tests shall include a check of the detection systems, the alarms and the releasing devices, including manual stations, fuel and power shutoff devices and other associated equipment.

913.5.1 Discharge test: All systems shall be tested by a discharge of expellant gas through the piping and nozzles with observations being made of the flow of expellant gas through all nozzles as well as observing for leakage and continuity of piping with free unobstructed flow.

780 CMR 914.0 STANDPIPE SYSTEMS

914.1 General: Standpipe systems shall be designed, installed and maintained in accordance with the provisions of 780 CMR and NFPA-14 listed in *Appendix A*. Where *standpipe systems* are required by 780 CMR, such systems shall be automatic wet systems. Automatic dry and semi-automatic dry *standpipe systems* shall be permitted only in areas subject to freezing. Complete *fire protection construction documents* shall be provided. (See 780 CMR 903.0.)

914.2 Where required: Class I *standpipe systems* shall be installed where required by 780 CMR 914.2.1 through 914.2.11 and shall be located in accordance with the provisions of NFPA 14, listed in *Appendix A*.

914.2.1 Use Group A: In all buildings or structures or portions thereof of Use Group A when:

1. Two or more stories in height of Use Group A-1, A-2, or A-3, and having an occupant load or more than 300; or;
2. Three or more stories in height regardless of the area per floor; or;
3. Having an auditorium seating over 500. Standpipes shall be located one on each side of the auditorium in each tier, one in each mezzanine, one in each tier of dressing rooms, and protecting each property, store and work room; or;
4. Having a stage. Standpipes shall be located on each side of the stage.

Such standpipes shall be not less that 2½-inch diameter, equipped with approved 1½ inch hose station.

914.2.2 Use Group B: In all buildings or structures or portions thereof of Use Group B when:

1. Three or more stories in height, and more than 3,000 square feet in area per floor; or;
2. Four or more stories in height regardless of the area per floor.

914.2.3 Use Group E: In buildings or structures or portions thereof of Use Group E when three or more stories in height regardless of the area per floor or when having a stage or auditorium in accordance with 780 CMR 914.2.1(3) and 914.2.1(4).

914.2.4 Use Group F: In all buildings or structures or portions thereof of Use Group F when:

1. Three or more stories in height, and more than 3,000 square feet in area per floor, or;
2. Four or more stories in height regardless of the area per floor.

914.2.5 Use Group H: In all buildings or structures or portions thereof of Use Group H when:

1. Three or more stories in height, and more than 10,000 square feet in area per floor; or;
2. Four or more stories in height, regardless of the area per floor.

914.2.6 Use Group I: In all buildings or structures or portions thereof of Use Group I, three or more stories in height, regardless of the area per floor.

914.2.7 Use group M: In all buildings or structures or portions thereof of Use Group M when:

1. Three stories or more in height, and more than 3,000 square feet in area per floor, or;
2. Four or more stories in height regardless of the area per floor, or;
3. Classified as a covered mall building within the mall portions (see 780 CMR 4).
4. Classified as a bulk/merchandising warehouse. (See 780 CMR 4.)

914.2.8 Use Group R-1 and R-2: In all buildings or structures or portions thereof of Use Group R-1 and R-2 when:

1. Three or more stories in height and of Use Group R-1 regardless of the area per floor; or;
2. Three or more stories in height and more than 10,000 square feet in area per floor, or;
3. Four or more stories in height regardless of the area per floor.

914.2.9 Use Group S: In all buildings or structures or portions thereof of Use Group S, other than public garages which shall conform to 780 CMR 914.2.10 when:

1. Three or more stories in height, or Use Group S-1, and more than 3,000 square feet in area per floor; or;
2. Three or more stories in height, Use Group S-2, and more than 10,000 square feet in area per floor; or;
3. Four or more stories in height of Use Groups S-1 or S-2 regardless of the area per floor.

914.2.10 Use Group U: In all buildings or structures or portions thereof of Use Group U when:

1. Three or more stories in height and more than 10,000 square feet in area per floor; or;
2. Four or more stories in height regardless of the area per floor.

914.2.11 Public Garages: In all Group I and 11 public garages and open parking structures when:

1. More than 10,000 square feet in area per floor; or;
2. More than 7,500 square feet in area per floor and more than **one story** in height; or;
3. More than 5,000 square feet in area per floor, and more than two stories in height; or;
4. More than three stories in height; or;
5. Located in buildings where the upper stories are designed for other uses: or;
6. When located in any story that is more than 50% below grade.

Exception: Standpipe systems can be "Class I Manual Dry Type" as defined by NFPA-14 for open parking structures less than 70' in height.

914.3 Standpipe system piping sizes: The riser piping, supply piping, and the water service piping shall be hydraulically sized in accordance with the provisions of NFPA-14 listed in *Appendix A*.

Exception: The residual pressure(s) as noted in NFPA-14 are not required to be maintained in buildings less than 70 feet in height which are equipped throughout with an approved automatic fire suppression system. However the system shall be designed to accommodate the outlet pressures and water flows in accordance with NFPA 14 and inlet pressures consistent with local fire department equipment..

914.4 High-rise buildings: All buildings more than 70 feet in height above the mean grade shall have each floor supplied by a minimum of two combination standpipe/sprinkler risers installed in accordance with the requirements of NFPA-14, listed in *Appendix A*.

914.5 Outlets: Standpipe system outlets shall comply with the provisions for, Class III Systems of NFPA-14 as listed in *Appendix A*.

914.6 Acceptance Tests: All Standpipe systems shall be tested in accordance with NFPA listed in *Appendix A*.

914.6.1 Underground Connections: Underground mains and lead-in connections shall be flushed and tested in accordance with NFPA 14 and NFPA 24 listed in *Appendix A*.

914.7 Standpipe system requirements for buildings under construction or demolition:

914.7.1 General: Standpipes required by 780 CMR 914.7 are to be either temporary or permanent in nature, with or without a water supply, provided, however, that such standpipes conform to the requirements of 780 CMR 914.0 as to number of risers, capacity, outlets and materials.

914.7.2 Buildings under construction or demolition: Standpipe requirements for buildings under construction or demolition shall be in accordance with the provisions of 780 CMR 3305.3 and NFPA 241 as listed in *Appendix A*.

780 CMR 915.0 FIRE DEPARTMENT CONNECTIONS

915.1 Required: All required water fire-extinguishing and *standpipe systems* shall be provided with a fire department connection in accordance with the applicable NFPA standards. Standpipes in buildings under construction or systems shall not be installed unless approved by the code official and by the local fire department. Where a presignal or positive alarm sequence system is installed, 24-hour supervision by trained personnel shall be provided at a location approved by the local fire department, in order that the alarm signal can be actuated in the event of fire or other emergency.

917.7.3 Zones: Each floor shall be zoned separately and a zone shall not exceed 20,000 square feet (1860 m^2). The length of any zone shall not exceed 300 feet (91440 mm) in any direction. A zoning indicator panel and the associated controls shall be provided in a location approved by the local fire department. Where individually addressable alarm initiating devices are used, a single circuit (or pathway) shall not exceed the above size limitations unless the circuit is a Class A circuit, and the style and device loading meets the requirements for proprietary systems as listed in NFPA 72. Where individually addressable alarm initiating devices are logically combined into groups for annunciation purposes, the above zone size limitations shall apply to the group. The local fire department shall approve all zone and point descriptions. The visual zone indication shall lock in until the system is reset and shall not be canceled by the operation of an audible alarm - silencing switch. In buildings that have floors located more than 70 feet above mean grade, a separate zone by floor shall be provided for the following types of alarm-initiating devices where provided:

1. Smoke detectors;
2. *Sprinkler* water-flow devices;
3. Manual fire alarm boxes; and
4. Other approved types of automatic fire detection devices, extinguishing, or *suppression systems.*

Exceptions:

1. *Automatic sprinkler system* zones shall not exceed the area permitted by NFPA 13 listed in *Appendix A*.
2. Duct type smoke detectors shall be separately identified with a remote test/ indicator station. The location of the remote test/indicator shall be approved by the local fire department.

917.8 Alarm notification appliances: Alarm notification appliances of the approved type shall be provided.

917.8.1 Visible alarms: Visible alarm notification appliances shall be provided in accordance with NFPA 72 and 521 CMR in public and common areas of all buildings and areas of buildings housing the hearing impaired and where required by 521CMR. In occupancies in Use Groups I-1 and R-1, all required accessible sleeping rooms and suites plus an additional number of sleeping rooms or suites in accordance with Table 917.8.1 shall be provided with a visible alarm notification appliance, activated by both the in-room smoke detector and the building fire protective signaling system. In hospital intensive care units, special care units and operating rooms, the audible signal need not be sounded; however a visual alarm shall be displayed with an approved device.

917.8.1.1 Visible alarm synchronization: Where more than one visible signal can be viewed from one location the visible signals shall be synchronized.

Table 917.8.1
VISIBLE AND AUDIBLE ALARMS

Number of sleeping rooms or suites	Sleeping rooms or suites with visible and audible alarms
6 to 25	1
26 to 50	2
51 to 75	3
76 to 100	4
101 to 150	5
151 to 200	6
201 to 300	7
301 to 400	8
401 to 500	9
501 to 1,000	2% of total
1,001 and over	20 plus 1 for each 100 over 1,000

917.8.2 Audible alarms: Audible alarm notification appliances shall be provided and shall sound a distinctive sound which shall not be used for any purpose other than that of a fire alarm. The audible alarm notification appliances shall provide a sound pressure level of 15 dBA above the average ambient or 5 dBA above the maximum sound level having a duration of at least 60 seconds (whichever is greater) sound level in every occupied space within the building. The minimum sound pressure levels shall be: 70 dBA in occupancies in Use Groups R and I-1; 90 dBA in mechanical equipment rooms; and 60 dBA in all other use groups. The maximum sound pressure level for audible alarm notification appliances shall be 120 dBA at the minimum hearing distance from the audible appliance.

917.8.2.1 All audible evacuation signals shall have a synchronized three - pulse temporal pattern in accordance with NFPA 72.

917.9 Voice/alarm signaling system: A voice/alarm signaling system shall be provided where required by other sections of 780 CMR. When activated in accordance with 780 CMR 917.7.1, the voice/alarm signaling system shall automatically sound an alert signal to all occupants within the building on a general or selective basis to the following terminal areas: elevators, elevator lobbies, *corridors, exit stairways,* rooms and tenant spaces exceeding 1,000 square feet (93 m^2) in area; *dwelling units* in occupancies in Use Group R-2; and guestrooms or suites in occupancies in Use Group R-1. The *fire command station* shall contain controls to transmit manually an evacuation signal and voice instructions on a selective and all-call basis to the terminal areas indicated herein. The voice/alarm system shall be designed and installed in accordance with the provisions of 780 CMR, 527 CMR and NFPA 72 listed in *Appendix A*.

Exceptions:
1. A distinctive signal in lieu of a voice alarm is permitted in an occupancy in Use Group F or S.
2. Where the head of the fire department or his/her designee determines that partial or selective evacuation is not desired, but rather total evacuation is required, then a distinctive signal, in lieu of a voice alarm, is permitted.

917.9.1 The sequence of operation of the voice alarm signaling system shall be as follows:

1. Sound an alert (pre-signal) tone (the alert tone shall be a 900 hertz tone pulsed to produce one round of code 4 at approximately one second intervals.
2. Activate the recorded message regarding the evacuation procedure. The alarm and communications system shall provide a pre-recorded message to all required areas. The message shall contain the following information. " attention please. The signal tone you have just head indicated a report of an emergency in this building. If your floor evacuation signal sounds after this message, walk to the nearest stairway and leave the floor. While the report is being verified, occupants on other floors should await further instructions."

   This message shall be transmitted three times.

   A female voice shall be used for this message.
3. Activate the evacuation signal on the floor of incident and the next floor above and below (the evacuation signal shall be in accordance with 780 CMR 917.8.2.1

917.10 Acceptance tests: Upon completion of the fire protective signaling system, all alarm notification devices and circuits, alarm indicating appliances and circuits, supervisory-signal initiating devices and circuits, signaling line circuits, and primary and secondary power supplies shall be subjected to a 100% acceptance test in accordance with NFPA 72 listed in *Appendix A* and 780 CMR 903.0.

780 CMR 918.0 AUTOMATIC FIRE DETECTION SYSTEMS (FIRE ALARM SYSTEMS)

918.1 General: Automatic fire detection systems shall be of an approved type and shall be installed in accordance with the provisions of 780 CMR and NFPA 72 listed in *Appendix A*.

918.2 Fire Protection Construction documents: Where an automatic fire detection system is required by 780 CMR, the *fire protection construction documents* shall show the location and number of all *automatic fire detectors* with specifications of the type of fire detector, proposed zoning and a complete sequence of operation for the system. The system shall be installed in accordance with 780 CMR 918.0 and shall be part of and be subject to the requirements of a fire protective signaling system specified in 780 CMR 917.0. (Also see 780 CMR 903.0)

918.3 Approval: All devices, combinations of devices, appliances and equipment shall be approved for the fire signaling purpose for which such equipment is used. The *automatic fire detectors* shall be smoke detectors, except an approved alternative type of detector shall be installed in spaces such as boiler rooms where, during normal operation, products of combustion are present in sufficient quantity to actuate a smoke detector.

918.4 Where required: An *automatic fire detection system* shall be installed and maintained in full operating condition in the locations described in 780 CMR 918.4.1 through 918.4.7.

918.4.1 Use Group A-4: An *automatic fire detection system* shall be installed in all occupancies of use group A-4.

918.4.2 Use Group E: An *automatic fire detection system* shall be installed in all occupancies of use group E.

918.4.3 Use Group I-1: An *automatic fire detection system* shall be installed and maintained in all occupancies in Use Group I-1.

918.4.4 Use Group I-2: An *automatic fire detection system* shall be installed and maintained in all occupancies in Use Group I-2.

Exception: Occupancies that are equipped throughout with an *automatic sprinkler system* in accordance with 780 CMR 906.0 and that comply with 780 CMR 409.0.

918.4.5 Use Group I-3: An *automatic fire detection system* shall be installed and maintained in all resident housing areas of Use Group I-3. Smoke detectors shall be arranged and positioned to prevent damage or tampering provided that the function and speed of detecting a fire is equivalent to that provided by the spacing and arrangement requirements of NFPA 72 listed in *Appendix A*.

918.4.6 Use Group R-1: An automatic fire detection system shall be installed and maintained throughout all occupancies in Use Group R-1 and in accordance with Table 918.

TABLE 918
RESIDENTIAL FIRE PROTECTION REQUIREMENTS

Use Group	Number of Units	Unit Occupant Protection	Other Occupant Protection	Standby Power	Manual Stations	Zoned	Provision for Fire Department Notification
R-3	1 or 2	Yes 919.3.2	Note a.	Yes 919.5	N.A.	N.A.	N.A.
R-1	3 to 12	Yes 919.3.1	Yes 918.4.6	Yes 917.6	Yes 917.4.5	N.A.	N.A.
R-2	3 to 12	Yes 919.3.2	Yes 918.4.7	Yes 919.5	Yes 917.4.6	N.A.	N. A.
R-1	13 or more	Yes 919.3.1	Yes 918.4.6	Yes 917.6	Yes 917.4.5	Yes 917.7.3	Yes 923.2
R-2	13 or more	Yes 919.3.2	Yes 918.4.7	Yes 919.5	Yes 917.4.6	Yes 917.7.3	Yes 923.2

Note a: Where common areas exist.

Exceptions:

1. An *automatic fire detection system* is not required in buildings that do not have interior *corridors serv*ing guestrooms or dwelling units and where all guestrooms or dwelling units have a *means of egress* door opening directly to an exterior *exit access* which leads directly to the *exits*.
2. Guest rooms or dwelling units single or multiple station smoke detectors required by 780 CMR 919.3.1 shall also be annunciated by guest room or dwelling unit at a constantly attended location from which the fire protective signaling system is capable of being manually activated. Detector annunciation shall be capable of operation from stand-by battery or be connected to an emergency electrical system. System smoke detectors shall be permitted providing they operate as follows: a. Provide unit occupant notification; b. Annunciate at a constantly attended location from which the fire protective signaling system is capable of being manually activated; c. Does not automatically activate the building notification appliances; d. Does not automatically activate the supervision requirements of 780 CMR 923.2; e. Be capable of operation including the required annunciation from stand-by battery.
3. A system heat detector shall be required within each guest room or *dwelling unit* located not more than six feet from each door way that leads to an interior *corridor* or exit. System heat detectors shall not be required where the guestroom or *dwelling unit* is equipped with residential *sprinklers* that when activated will activate the fire protective signaling system.

918.4.7 Use Group R-2: An *automatic fire detection* system shall be installed and maintained throughout all occupancies in use group R-2 and in accordance with table 918.

Exceptions:

1. An *automatic fire detection system* is not required in buildings that do not have interior *corridors serv*ing guestrooms or *dwelling units* and where all guestrooms or *dwelling units* have a *means of egress* door opening directly to an exterior *exit access* which leads directly to the *exits*.
2. System smoke detectors are not required in guestrooms or *dwelling units*.
3. A system heat detector shall be required within each guest room or *dwelling unit* located not more than six feet from each door way that leads to an interior *corridor* or exit. System heat detectors shall not be required where the guestroom or dwelling unit is equipped with residential sprinklers that, when activated, will activate the fire protective signaling system.

918.5 Sprinklered buildings exception: Buildings equipped throughout with an *automatic sprinkler system* in accordance with 780 CMR 906.2.1 or 780 CMR 906.2.2 are not required to be equipped with an automatic fire detection system, but are required to be equipped with a fire protective signaling system that conforms to 780 CMR 917.0. This exception does not apply to Use Groups I, R-1, R-2, to high-hazard use groups in accordance with 780 CMR 417.5.3, to special amusement buildings in accordance with 780 CMR 413.0, or to single-station smoke detectors as required in 780 CMR 919.3.

918.6 Zones: Zoning shall be provided in accordance with 780 CMR 917.7.3.

918.7 Alarm verification: Alarms activated by smoke detectors required by 780 CMR 918.0 shall be activated by a single smoke detector monitored by an *alarm verification* zone or an approved equivalent method.

918.8 Local control functions: *Automatic fire detectors* utilized for the purpose of performing local control functions shall be a part of a fire protective signaling system. The detector shall, upon actuation, perform the intended function and activate the alarm notification devices or activate a visible and audible supervisory signal at a constantly attended location.

Exception: In buildings not required to be equipped with a fire protective signaling system, the *automatic fire detector shall* be powered by normal electrical service and, upon actuation, perform the intended function. The detectors shall be located in accordance with NFPA 72 listed in ***Appendix A***. This exception does not apply to smoke detectors required for elevator recall.

918.9 Access: Access shall be provided to each detector for periodic inspection, maintenance and testing.

780 CMR 919.0 SINGLE- AND MULTIPLE-STATION SMOKE DETECTORS

919.1 General: Single- and multiple-station smoke detectors shall be of an approved type and shall be installed in accordance with the provisions of 780 CMR and NFPA 72 listed in *Appendix A*.

919.1.1 A control and associated equipment, single or multiple station alarm devices or any combination thereof shall be permitted to be used as a *household fire warning system* provided that the requirements of NFPA 72 Chapter 2 are met.

919.2 Fire Protection Construction documents: Where single- and multiple station smoke detectors are required by 780 CMR, the *fire protection construction documents* shall show the location and number with specifications of the type of detector. (Also see 780 CMR 903.0.)

919.3 Where required: Single and multiple station smoke detectors or household fire warning systems shall be installed and maintained in full operating condition in the locations described in 780 CMR 919.3.1 through 919.3.3. Any smoke detector located within 20 feet of a kitchen or within 20 feet of a bathroom containing a tub or shower shall be a photo electric type smoke detector.

919.3.1 Use Group R-1: Single and multiple station smoke detectors or household fire warning systems shall be installed and maintained in the following locations in Use Group R- 1:

1. In all sleeping areas;
2. In every room or hallway in the path of the *means of egress* from the sleeping area to the door leading from the guestroom or suite; and
3. In each story within the guestroom or suite, including *basements*.

Exception: For suites or guestrooms or *dwelling unit* with split levels and without an intervening door between the adjacent levels, a smoke detector installed on the upper level shall suffice for the adjacent lower level provided that the lower level is less than one full story below the upper level.

919.3.2 Use Groups R-2, R-3, R-4 and R-5: Single and multiple station smoke detectors or household fire warning systems shall be installed and maintained in all occupancies in Use Groups R-2, R-3, R-4 and R-5 at the following locations:

1. In the immediate vicinity of bedrooms;
2. In all bedrooms; and
3. In each story within a *dwelling unit*, including *basements*.
4. In Residential Units of 1200 sq. ft. or more, Automatic Fire Detectors, in the form of Smoke Detectors shall be provided for each 1200 square feet of area or part thereof;

Exceptions:

1. In *dwelling units* with split levels and without an intervening door between the adjacent levels, a smoke detector installed on the upper level shall suffice for the adjacent lower level provided that the lower level is less than one full story below the upper level.
2. In buildings equipped throughout with an *automatic sprinkler system* installed in accordance with 780 CMR 906.2.1, 906.2.2 or 906.2.3, smoke detectors are not required in bedrooms where the bedrooms are equipped with residential sprinklers.

919.3.3 Use Group I-1: Single and multiple station smoke detectors or household fire warning systems shall be installed and maintained in all sleeping areas in occupancies in Use Group I- 1.

Exception: Where the building is equipped throughout with an automatic detection system in accordance with 780 CMR 918.4.

919.4 Interconnection: Where more than one detector is required to be installed within an individual *dwelling unit* in an occupancy in Use Group R-2 , R-3 or R4, or within an individual guestroom or suite in an occupancy in Use Group R-1, the detectors shall be wired in such a manner that the actuation of one alarm will actuate all of the alarms in the individual unit.

919.5 Battery backup: In addition to the required AC primary power source, required smoke detectors in occupancies in Use Groups R-2, R-3, R-4, R-5 and I-1 shall receive power from a battery when the AC primary power source is interrupted.

Exception: In buildings equipped throughout with an *automatic sprinkler system* installed in accordance with 780 CMR 906.2.1, 906.2.2 or 906.2.3.

919.6 Acceptance testing: When the installation of the detectors is complete, each detector - and all interconnecting wiring for multiple-station detectors shall be subject to a 100% acceptance test in accordance with NFPA 72 listed in *Appendix A*

780 CMR 920.0 FIRE EXTINGUISHERS

920.1 Approval: Portable fire extinguishers shall bear the label of an *approved agency*, be of an approved type and be installed in a location visible and available to the occupants.

CHAPTER 13

ENERGY CONSERVATION

(This Chapter is entirely unique to Massachusetts)

NOTE: The provisions of Chapter 13 specified herein apply to projects for which permit applications are made after January 1, 2001.

Exception: Between January 1, 2001 and June 30, 2001, projects may utilize either the provisions of Chapter 13 as specified herein, or the provisions of Chapter 13 specified in 780 CMR Sixth Edition effective 2/28/97.

780 CMR 1301.0 ADMINISTRATION

1301.1 Scope: 780 CMR 13 sets forth requirements for the effective use of energy in structures other than *low rise residential buildings*, which shall be designed and constructed to comply with the requirements of 780 CMR APPENDIX J.

> **Exception**: For the purposes of energy conservation, Use Group R-1 buildings are to be treated as *commercial buildings*.

1301.2 Compliance: Buildings shall be deemed to be in compliance with 780 CMR 13 when built to the provisions of 780 CMR 1301 and 1303, and either:

1. 780 CMR 1303 through 1308; or
2. 780 CMR 1309.

> **Exception**: As an alternative to the provisions of 780 CMR 1304, buildings with total floor area not greater than 10,000 square feet may be designed and constructed using the envelope requirements of 780 CMR APPENDIX J.

1301.2.1 Heating, Pumping, Process Piping and Refrigeration Systems: Heating, pumping, process piping and refrigeration systems shall be installed by contractors and personnel appropriately licensed in the Commonwealth of Massachusetts (Installing Contractor). Engineered designs and specifications prepared by Registered Professional Engineers shall identify systems requiring compliance with appropriate sections of M.G.L. c. 146 and 528 CMR. Shop drawings and design layout prepared by licensed installing contractors shall note the name(s), license number(s) and license expiration date(s) of the contractor(s) installing the heating, pumping, process piping and refrigeration systems. (See Installing Contractor Definition 780 CMR 202.0).

1301.3 Other Regulations: 780 CMR 13 is not intended to abridge any safety or health provisions required under any other applicable codes or ordinances.

1301.4 Existing Buildings: Nothing in 780 CMR 13 shall require the removal, alteration, or abandonment, or prevent the continuance of the use and occupancy of, a lawfully existing building, unless provided otherwise specifically by 780 CMR 13.

1301.5 Additions to Existing Buildings: Additions to existing buildings or structures shall be made without making the entire building or structure comply. The new construction shall conform to the provisions of 780 CMR 13 as they relate to the addition only.

1301.6 Alterations to Existing Buildings: See 780 CMR 3407.

1301.7 Exempt Buildings: The following buildings are exempt from the further provisions of 780 CMR 13, with the exception of 780 CMR 1308.0 dealing with lighting requirements:

1. Buildings and structures or portions thereof whose peak design rate of energy usage is less than one watt per square foot or three and four tenths (3.4) Btu/h per square foot of floor area for all purposes;
2. Buildings and structures or portions thereof which are neither heated nor cooled;
3. *Greenhouses* that are free-standing, or attached to a building and separated by a wall having the same thermal value as an exterior wall, and provided with a separate temperature control system;
4. Buildings with less than 100 square feet of gross floor area.
5. Portions of aircraft hangars where aircraft are housed or stored and/or aircraft servicing, repairs or alterations may occur. Such hangars are also exempt from the lighting requirements of 780 CMR 1308.

1301.8 Plans and Specifications

1301.8.1 General: Plans, specifications and necessary computations shall be submitted to indicate conformance with 780 CMR 1301.8 and other applicable sections of 780 CMR. Submittals shall include Mandatory Checklist approved by the Board of Building Regulations and Standards.

1301.8.2 Details: The data submitted shall show all pertinent information and features to be incorporated into the building, including but not limited to: the exterior envelope component materials; the R values of the respective elements; the U values of the overall assembly; calculations of overall Uo of the walls, roof/ceiling, and floors; the size and type of apparatus and equipment; controls; lighting requirements; and other pertinent data to indicate conformance to 780 CMR 13.

1301.8.3 Calculation Procedures: Calculation procedures shall be in accordance with the ASHRAE Handbook, 1997 Fundamentals Volume or as otherwise specified in 780 CMR 13.

1301.8.4 Approval and Acceptance of Heating, Ventilating, and Air Conditioning (HVAC); Lighting; and Electric Distribution Systems:

1301.8.4.1 Construction Documents: The construction documents shall contain sufficient information to completely describe the heating, ventilation, and air conditioning (HVAC); lighting; and electric power distribution systems, including operational features and controls. The information required for each system shall include a summary of:

1. A description of the design intent providing a detailed explanation of the ideas, concepts and criteria that are defined by the owner to be important.
2. A description of the basis of design of the systems including all information necessary to prepare a design to accomplish the design intent.
3. A description of the sequence of operation of the systems and their interaction with other systems, including fire prevention and fire protection systems.
4. A description of the systems including the capacities of the equipment or systems.
5. A description of the testing requirements and the criteria for passing to be used for final systems acceptance.
6. A requirement for submittal of operation manuals and maintenance manuals as a condition of final acceptance, and a description of their format and content. The operation manual shall provide all relevant information needed for day-to-day operation and management of each system. The maintenance manual shall describe equipment inventory and support the maintenance program.
7. A requirement for submittal of record drawings and control documents as a condition of final acceptance, per 780 CMR 116.0.

Approval by the building official of the design concepts, testing procedures, and acceptance criteria of 780 CMR 1301.8.4.1, 1. through 7., is not required, but the building official shall reject the construction documents if these sections are incomplete, or if they specify any design elements that violate other requirements of 780 CMR.

1301.8.4.2 Plans: All HVAC, lighting, and electric power distribution system plans shall contain sufficient information to identify the system and equipment arrangements, system and equipment sizing, systems specifications, systems sequence(s) of operation and tabulation of the building loads and building components for compliance with 780 CMR.

1301.8.4.3 Design: All HVAC, lighting, and electric power distribution systems including sequence of operation, controls and supporting documentation shall be designed and specified by a qualified Registered Professional Engineer except as provided in M.G.L. c. 143, § 54A and any profession or trade as provided in M.G.L. c. 112, § 60L and M.G.L. c. 112, § 81R. The Registered Professional Engineer(s) or other legally recognized professional (M.G.L. c. 112, § 81R) shall be responsible for the review and certification that all submittals and shop drawings conform to the approved HVAC, lighting, and electric power distribution construction documents as submitted for the building permit and approved by the building official, per 780 CMR 116.0.

1301.8.4.4 Acceptance: In accordance with the provisions of 780 CMR 120, a certificate of occupancy shall not issue until the building official or his designees have witnessed a satisfactory test of all HVAC, lighting control, and electric power distribution systems installed in accordance with the construction documents. All systems shall be tested in accordance with the applicable standards of 780 CMR and documents. In addition, the following documents shall be simultaneously submitted to the building official prior to the issuance of a permanent certificate of occupancy.

1. Certification from the Registered Professional, as allowed in 780 CMR 116.2, stating that the HVAC, lighting, and electric power distribution systems have been installed in substantial accord with the approved construction documents.
2. Confirmation by the building owner/ developer or authorized representative that they have received all HVAC, lighting, and electric power distribution system record drawings from the installing contractors and that the Registered Professional Engineer or other legally recognized professional (M.G.L. c. 112, § 81R) has reviewed their reasonable accuracy.
3. Confirmation by the building owner/ developer or authorized representative that they have received all construction documents required in 780 CMR 1301.8.4.1

including reports, controls documentation, operation manual(s) and maintenance manual(s).

Exception: In lieu of witnessing a satisfactory functional test, the building official or their designees may accept a final performance acceptance test report from a Registered Professional Engineer or other legally recognized professional (M.G.L. c. 112, § 81R). Said report shall certify that the systems have been tested and satisfactorily meet their performance requirements.

1301.8.4.5 Unsafe Lighting and Ventilation: The *building official* may require or accept the documentation required in 780 CMR 1301.8.4.4 in enforcing the provisions of 780 CMR 3400.6.

1301.8.4.6 Conditional Acceptance: The requirements of 780 CMR 1301.8.4.4 shall not preclude the issuance of a temporary certificate of occupancy by the Building Official in accordance with 780 CMR 120.3 as long as it can be demonstrated that compliance can be accomplished with the building occupied.

1301.9 Materials and Equipment

1301.9.1 Identification: Where practicable, all materials and equipment referenced in 780 CMR 1301.8 shall be marked in order to show compliance with 780 CMR 13.

1301.9.2 Maintenance Information: Service systems which require preventive maintenance to maintain efficient operation shall be furnished with complete necessary maintenance information. Required routine maintenance actions, as specified by the manufacturer, shall be stated clearly and incorporated on a readily accessible label on the equipment. Such label may be limited to identifying, by title or publication number, the operation and maintenance manual for that particular model and type of product.

1301.9.3 Fenestration and Doors: Product samples used for determining *fenestration* performance shall be production line units or representative of units as purchased by the consumer or contractor.

1301.9.3.1 U-Factor: *U-factors* shall be determined in accordance with AAMA 1503 or NFRC 100. *U-factors* for *skylights* shall be determined in accordance with NFRC 100. *U-factor* shall be determined by an independent laboratory accredited by a nationally recognized accreditation organization and shall be certified by the manufacturer.

Exceptions: If a manufacturer of windows, window systems, skylights, glazed or unglazed door has not determined product U-value in accordance with 1301.9.3.1, compliance with the requirements of 780 CMR 13 shall be determined only by assigning such products a default U-value in accordance with Table 1301.9.3.1a or 1301.9.3.1b. Product features must be verifiable for the product to qualify for the default value associated with those features. Where existence of a particular feature cannot be determined with reasonable certainty, the product shall not receive credit for that feature. Where a composite of materials from two different product types is used, the product shall be assigned the higher U-value.

For garage doors, NAGDM 105 shall be an acceptable alternate for determining U Factor.

Table 1301.9.3.1a
U-Value Default Table for Windows, Curtain Walls, and Skylights[a]

Frame Material and Product Type[b]	Single Glazed	Double Glazed	Double Glazed Low-e[c]	Triple Glazed	Triple Glazed Low-e[c]
Metal without Thermal Break					
Windows	1.27	0.87	0.79	0.72	0.69
Curtain Walls	1.22	0.79	0.70	0.63	0.59
Skylight	1.98	1.31	1.20	1.12	1.08
Site-assembled sloped/overhead glazing	1.36	0.82	0.71	0.64	0.60
Metal with Thermal Break					
Windows	1.07	0.63	0.54	0.48	0.44
Curtain Walls	1.11	0.68	0.59	0.52	0.48
Skylight	1.89	1.11	1.00	0.89	0.85
Site-assembled sloped/overhead glazing	1.25	0.70	0.60	0.53	0.49
Wood/Vinyl/Fiberglass					
Windows	0.98	0.56	0.48	0.41	0.37
Skylight	1.47	0.84	0.74	0.64	0.59

[a] Certain values in this table do not meet the limits of 780CMR 1304.2, Prescriptive Building Envelope Criteria, or 780 CMR 1305, Building Envelope Trade-Off Option, and may be used only when demonstrating compliance using 780CMR 1309, Building Design by Systems Analysis.

[b] Glass block assemblies with mortar but without reinforcing or framing shall have a default value of 0.60.

[c] Presence of low-e coating must be certified in writing by the manufacturer.

Table 1301.9.3.1b
U-value Default Table for Doors

Door Type	
Opaque	0.70
Glass	0.92
Air Lock Entry	0.50
Revolving	0.50
Overhead	1.45

1301.9.3.2 Solar Heat Gain Coefficient: Solar heat gain coefficient (SHGC) for the overall fenestration area shall be determined in accordance with NFRC 200. Solar heat gain coefficient shall be determined by an independent laboratory accredited by a nationally recognized accreditation organization and shall be certified by the manufacturer.

Exception: If a manufacturer of windows, window systems, skylights, glazed or unglazed door has not determined product Solar Heat Gain Coefficient in accordance with 780 CMR 1301.9.3.2, compliance with the requirements of 780 CMR 13 shall be determined only by assigning such products a default SHGC in accordance with Table 1301.9.3.2. Credit for low-e coating may be taken only if presence of such coating is certified in writing by the manufacturer.

1301.9.3.3 Visible Light Transmittance: When 780 CMR 1304.5 is used with daylighting credit, visible light transmittance shall be determined in accordance with NFRC 200. Visible light transmittance shall be determined by an independent laboratory accredited by a nationally recognized accreditation organization and shall be certified by the manufacturer.

Exception: If a manufacturer of windows, window systems, skylights, glazed or unglazed door has not determined product Visible Light Transmittance in accordance with 780 CMR 1301.9.3.3, compliance with the requirements of 780 CMR 13 shall be determined only by assigning such products a default VLT in accordance with Table 1301.9.3.2. Credit for low-e coating may be taken only if presence of such coating is certified in writing by the manufacturer.

Table 1301.9.3.2
SHGC and VLT Default Table for Fenestration[a]

Glass Type	Metal Frame		Non-Metal Frame	
	SHGC	VLT	SHGC	VLT
Single Glazed				
Clear	0.78	0.80	0.76	0.78
Tinted	0.67	0.61	0.65	0.59
Reflective	0.53	0.37	0.52	0.36
Double Glazed				
Clear	0.68	0.72	0.66	0.70
Tinted	0.57	0.55	0.56	0.54
Reflective	0.46	0.32	0.45	0.31
Double Glazed Low-e				
Clear	0.64	0.68	0.63	0.66
Tinted	0.59	0.50	0.58	0.49
Reflective	0.46	0.32	0.45	0.31
Triple Glazed				
Clear	0.61	0.66	0.60	0.64
Tinted	0.42	0.22	0.41	0.22
Reflective	0.36	0.25	0.35	0.25
Triple Glazed Low-e				
Clear	0.57	0.61	0.56	0.59
Tinted	0.42	0.33	0.41	0.32
Reflective	0.36	0.25	0.35	0.25

[a] Presence of low-e coating must be certified in writing by the manufacturer.

780 CMR 1302.0 DEFINITIONS

1302.1 Meaning: Unless otherwise expressly stated, the following terms shall, for the purpose of 780 CMR Chapter 13, have the meaning indicated below.

1302.2 Tense, Gender and Number: Words used in the present tense include the future; words used in the masculine gender include the feminine and neuter; the singular number includes the plural and the plural the singular.

1302.3 Terms not Defined: Where terms are not defined, they shall have their ordinarily accepted meanings or such as the context may imply. Any terms relating to plumbing and electrical wiring shall have their terms as defined by the Regulations of the Commonwealth of Massachusetts pertaining to plumbing and electrical wiring.

Accessible (as Applied to Equipment): Admitting close approach because not guarded by locked doors, elevation or other effective means (see "Readily accessible").

Air Conditioning, Comfort: The process of treating air so as to control simultaneously its temperature, humidity, cleanliness, and distribution to meet requirements of the conditioned space.

Air Transport Factor: The ratio of the rate of useful sensible heat removal from the conditioned space to the energy input to the supply and return fan motor(s), expressed in consistent units and under the designated operating conditions.

Automatic: Self-acting, operating by its own mechanism when actuated by some impersonal influence, as, for example, a change in current strength, pressure, temperature or mechanical configuration (see "Manual").

Ballast: A device used in conjunction with an electric-discharge lamp to cause the lamp to start and operate under the proper circuit conditions of voltage, current, wave form, electrode heat, etc.

Electronic Ballast: A ballast constructed using electronic circuitry.

Hybrid Ballast: A ballast constructed using a combination of magnetic core and insulated wire winding and electronic circuitry.

Magnetic Ballast: A ballast constructed with magnetic core and a winding of insulated wire.

Below-grade Wall: The opaque portion of a wall which encloses one side of a basement and is partially or totally below grade.

Boiler: An appliance designed to heat water or generate steam (see "Packaged boiler".)

Building Area: The greatest horizontal area of a building above grade within the outside surface of exterior walls or within the outside surface of exterior wall and the center line of fire walls.

Building Envelope: The elements of a building which enclose conditioned spaces through which thermal energy may be transferred to or from the exterior or to or from unconditioned spaces or other spaces exempted by the provisions of 780 CMR 1301.7.

Building Entrance: Any doorway, set of doors, turnstiles, or other form of portal that is ordinarily used to gain access to the building by its users and occupants.

Building Grounds Lighting: Lighting provided through a building's electrical service for parking lot, site, roadway, pedestrian pathway, loading dock, and security applications.

Building Project: A building or group of buildings, including on-site energy conversion or electric-generating facilities, which utilize a single submittal for a construction permit or are within the boundary of a contiguous area under one ownership.

Coefficient of Performance (COP) - Heat Pump - Heating: The ratio of the rate of heat delivered to the rate of energy input, in consistent units, for a complete heat pump system under designated operating conditions.

Comfort: The physical conditions represented in the area on a psychometric chart enclosing all those conditions described in Figure 1 in ASHRAE 55, as listed in *Appendix A*, as being comfortable.

Commercial Building: For purposes of energy conservation, a commercial building is any building other than a low-rise residential building, as defined in 780 CMR J2.0.

Conditioned Floor Area: The horizontal projection of that portion of interior space which is contained within exterior walls and which is conditioned directly or indirectly by an energy-using system.

Conditioned Pace: Space within a building which is provided with positive heat supply (see definition), or which has heated and/or cooled air or surfaces, or where required, with humidification or dehumidification means so as to be capable of maintaining a space condition falling within the comfort zone set forth in ASHRAE 55, as listed in *Appendix A*.

Continuous Insulation (ci): Insulation that is continuous across all structural members without any thermal bridges, excluding fasteners and service openings. It is installed on the interior, exterior, or integral to any opaque surface of the building envelope.

Control Device: A specialized device used to regulate the operation of equipment.

Dead Band: The temperature range in which no heating or cooling is used.

Degree Day, Cooling (CDD): A unit, based upon temperature difference and time, used in estimating cooling energy consumption. For any one day, when the mean temperature is more than 65°F, there are as many degree days as degrees Fahrenheit temperature difference between the mean temperature for the day and 65°F. Annual Cooling Degree Days (CDD) are the sum of the degree days over a calendar year.

Degree Day, Heating (HDD): A unit, based upon temperature difference and time, used in estimating fuel consumption and specifying nominal heating load of a building in winter. For any one day, when the mean temperature is less than 50°F, there exists as many degree days as there are Fahrenheit degrees difference in temperature between the mean temperature for the day and 50°F. Annual Heating Degree Days (HDD) are the sum of the degree days over a calendar year.

Design Conditions: Specified environmental conditions, such as temperature and light intensity, required to be produced and maintained by a system and under which the system must operate.

Direct Digital Control (DDC): A type of control where controlled and monitored analog or binary data (e.g., temperature, contact closures) are converted to digital format for manipulation and calculations by a digital computer or microprocessor, then converted back to analog or binary form to control physical devices.

Distribution System: Conveying means, such as ducts, pipes, and wires, to bring substances or energy from a source to the point of use. The distribution system includes such auxiliary equipment as fans, pumps, and transformers.

Door: All operable opening areas (which are not fenestration) in the building envelope, including swinging and roll-up doors, fire doors, and access hatches. Doors that are more than one-half glass are considered fenestration. (See Fenestration.) For the purposes of determining building envelope requirements, the classifications are defined as follows:

Non-swinging: Roll-up, sliding, and all other doors that are not swinging doors.
Swinging: All operable opaque panels with hinges on one side and opaque revolving doors.

Door Area: Total area of the door measured using the rough opening and including the door slab and the frame. (See "Fenestration area.")

Economizer, Air: A duct and damper arrangement and automatic control system that together allows a cooling system to supply outside air to reduce or eliminate the need for mechanical cooling during mild or cold weather.

Economizer, Water: A system by which the supply air of a cooling system is cooled indirectly with water that is itself cooled by heat or mass transfer to the environment without the use of mechanical cooling.

Efficiency: Performance at specified rating conditions.

Efficiency, HVAC System: The ratio of useful energy output (at the point of use) to the energy input in consistent units for a designated time period, expressed in percent.

Emergency Power System: A system that operates in the event of primary system failure or provides power to essential loads during power supply outages.

Enclosed Space: A volume substantially surrounded by solid surfaces such as walls, floors, roofs, and openable devices such as doors and operable windows.

Enclosure: The case or housing of an apparatus, or the fence or walls surrounding an installation, to prevent personnel from accidentally contacting energized parts or protect equipment from physical damage.

Energy: The capacity for doing work taking a number of forms which may be transformed from one into another, such as thermal (heat), mechanical (work), electrical and chemical in customary units, measured in kilowatt-hours (kWh) or British thermal units (Btu).

Energy Efficiency Ratio (EER): The ratio of net equipment cooling capacity in Btu/h to total rate of electric input in watts (W) under designated operating conditions. If the output capacity in Btu/h is converted to watts (to create consistent units) the result is equal to the cooling COP (EER 3.41 = COP.) See also Coefficient of Performance.

Energy, Recovered: (See "Recovered energy.")

Exfiltration: The uncontrolled outward air leakage through cracks and interstices in any building element and around windows and doors of a building caused by the pressure effects of wind and/or the effect of differences in the indoor and outdoor air density.

Existing Buildings: For purposes of energy conservation, and existing building which has been legally occupied and/or used for a period of at least five years. (Also see 780 CMR 2.0 and 780 CMR 3400.3.1.)

Exterior Lighting Power Allowance: (See "Lighting power allowance.")

Facade Area, Vertical: Area of the facade, including nonhorizontal roof area, overhangs, and cornices, measured in elevation in a vertical plane parallel to the plane of the face of the building.

F-factor: The perimeter heat loss factor for slab-on-grade floors, expressed in Btu/h*ft*°F.

Fan System Energy Demand (or Fan System power): The sum of the nominal power demand (nameplate horsepower) of motors of all fans that are required to operate at design conditions to supply air from the heating or cooling source to the conditioned space(s) and return it to the source or exhaust it to the outdoors.

Fenestration: All areas (including the frames) in the building envelope that let in light, including windows, plastic panels, clerestories, skylights, glass doors that are more than one-half glass, and glass block walls. (See Building envelope and Door.)

Skylight: A fenestration surface having a slope of less than 60° from the horizontal plane. Other fenestration, even if mounted on the roof of a building, is considered vertical fenestration.

Vertical Fenestration: All fenestration other than skylights.

Fenestration Area: Total area of the fenestration measured using the rough opening and including the glazing, sash, and frame. For doors where the glazed vision area is less than 50% of the door area, the fenestration area is the glazed vision area. For all other doors, the fenestration area is the door area. (See "Door area.")

Fenestration, Vertical: (See "Fenestration" and "Skylight.")

Fixture: The component of a luminaire that houses the lamp or lamps, positions the lamp, shields it from view, and distributes the light. The fixture also provides for connection to the power supply, which may require the use of a ballast..

Floor: That lower portion of the building envelope, including opaque area and fenestration, that has conditioned or semiheated space above and is horizontal or tilted at an angle of less than 60 degrees from horizontal but excluding slab-on-grade floors. For the purposes of determining building envelope requirements, the classifications are defined as follows:

Mass Floor: A floor with a heat capacity that exceeds (1) seven Btu/ft^2*°F or (2) five Btu/ft^2*°F provided that the floor has a material unit weight not greater than 120 lb/ft^3.

Steel Joist Floor: A floor that (1) is not a mass floor and (2) which has steel joist members supported by structural members.

Wood Framed and Other Floors: All other floor types, including wood joist floors.

(See "Building envelope", "Fenestration", "Opaque area", and "Slab-on-grade floor.")

Floor Area, Gross: The sum of the floor areas of the spaces within the building including basements, mezzanine and intermediate-floored tiers, and penthouses with headroom height of 7.5 ft (2.3 m) or greater. It is measured from the exterior faces of exterior walls or from the centerline of walls separating buildings, but excluding covered walkways, open roofed-over areas, porches and similar spaces, pipe trenches, exterior terraces or steps, chimneys, roof overhangs, and similar features.

Gross Building Envelope Floor Area: The gross floor area of the building envelope, but excluding slab-on-grade floors.

Gross Conditioned Floor Area: The gross floor area of conditioned spaces.

Gross Lighted Floor Area: The gross floor area of lighted spaces.

Gross Semiheated Floor Area: The gross floor area of semiheated spaces.

(See "Building envelope", "Floor", "Slab-on-grade floor," and "Space.")

Flue Damper: A device in the flue outlet or in the inlet of or upstream of the draft control device of an individual, automatically operated, fossil fuel-fired appliance that is designed to automatically open the flue outlet during appliance operation and to automatically close the flue outlet when the appliance is in a standby condition.

Fossil Fuel: An organic material, other than wood, used as a fuel.

Footcandle (fc): The illuminance on a surface one ft^2 in area on which there is a uniformly distributed flux of one lm, or the illuminance produced on a surface all points of which are at a distance of one ft from a directionally uniform point source of 1 cd. (For SI users, one footcandle equals 10.76 lux.)

Furnace, Duct: A furnace normally installed in distribution ducts of air conditioning systems to supply warm air for heating and which depends on a blower not furnished as part of the duct furnace for air circulation.

Furnace, Warm Air: A self-contained, indirect-fired or electrically heated furnace that supplies heated air through ducts to spaces that require it.

Glazed Wall System: A category of site assembled fenestration products used in the NFRC 100 and NFRC 200 rating procedures which includes, but is not limited to, curtainwalls and solariums.

Grade: The finished ground level adjoining a building at all exterior walls.

Glazing Area: Interior surface area of all glazed surfaces (such as windows, sliding glass doors, skylights, etc.), sash, curbing, jambs, or other framing elements that enclose conditioned spaces.

Gross Area of Exterior Walls: The normal projection of the building envelope wall area bounding interior space which is conditioned by an energy-using system including opaque wall, window and door area.

The gross area of exterior walls consists of all opaque wall areas, including between floor spandrels, peripheral edges of floors, roof and basement knee walls, walls enclosing a mansard roof, window areas including sash, and door areas when such surfaces are exposed to outdoor air, unconditioned spaces, or mechanically cooled space, including interstitial areas between two such spaces. For each basement wall that encloses heated space, if the average below-grade area is less than 50% of the total area for that wall, including openings, the entire wall, including the below-grade portion is included as part of the gross area of exterior walls. Non-opaque areas (windows, doors, etc.) of all basement walls are included in the gross area of exterior walls. (Note: if the basement is not heated space, and if the basement ceiling is insulated, then the basement walls are not included in the gross area of exterior walls.

Gross floor area: The sum of the areas of the several floors of the building, including basements, cellars, mezzanine and intermediate floored tiers and penthouses of headroom height, measured from the exterior faces of exterior walls or from the center line of walls separating buildings, but excluding:

1. covered walkways, open roofed-over areas, porches and similar spaces.
2. pipe trenches, exterior terraces or steps, chimneys, roof overhangs and similar features.

Group R Residential Buildings: For the purpose of Appendix J, Group R residential buildings include:

1. detached one and two family dwellings (use groups R-4 and R-5 in 780 CMR 310); and,
2. all other residential buildings, three stories or less in height (use groups r-1, r-2, r-3, r-5 in 780 CMR 310).

Heat: The form of energy that is transferred by virtue of a temperature difference or a change in state of a material.

Heated Space: Space within a building which is provided with a positive heat supply. Space within a basement with registers or heating devices designed to supply heat to a basement space shall automatically define that space as heated space.

Humidistat: An automatic control device used to maintain humidity at a fixed or adjustable set point.

HVAC: Heating, ventilating, and air conditioning.

HVAC System: The equipment, distribution network, and terminals that provide either collectively or individually the processes of heating, ventilating, or air conditioning to a building.

HVAC System Components: HVAC system components provide, in one or more factory-assembled packages, means for chilling and/or heating water with controlled temperature for delivery to terminal units serving the conditioned spaces of the building. Types of HVAC system components include, but are not limited to, water chiller packages, reciprocating condensing units and water source (hydronic) heat pumps (See "HVAC system equipment").

HVAC System Efficiency: (See "Efficiency, HVAC system.")

HVAC System Equipment: HVAC system equipment provides, in one (single package) or more (split system) factory-assembled packages, means for air circulation, air cleaning, air cooling with controlled temperature and dehumidification, and, optionally, either alone or in combination with a heating plant, the functions of heating and humidifying. The cooling function may be either electrically or heat operated and the refrigerant condenser may be air, water or evaporatively cooled. Where the equipment is provided in more than one package, the separate packages shall by designed by the manufacturer to be used together. The equipment may provide the heating function as a heat pump or by the use of electric or fossil-fuel-fired elements. (The word "equipment" used without modifying adjective may, in accordance with common industry usage, apply either to HVAC system equipment or HVAC system components.)

Indirectly Conditioned Space: (See "Space.")

Infiltration: The uncontrolled inward air leakage through cracks and interstices in any building element and around windows and doors of a building caused by the pressure effects of wind and/or the effect of differences in the indoor and outdoor air density.

Installed Interior Lighting Power: The power in watts of all permanently-installed general, task, and furniture lighting systems and luminaires as indicated on plans and specifications.

Integrated Part-load Value (IPLV): A single number figure of merit based on part-load EER or COP expressing part-load efficiency for air-conditioning and heat pump equipment on the basis of weighted operation at various load capacities for the equipment.

Interior Lighting Power Allowance: (See "Lighting power allowance.")

Isolation Devices: Devices that isolate HVAC zones so that they can be operated independently of one another. Isolation devices include, but are not limited to, separate systems, isolation dampers, and controls providing shutoff at terminal boxes.

Lighting Power Allowance:

Interior Lighting Power Allowance: The maximum lighting power in watts allowed for the interior of a building.

Exterior Lighting Power Allowance: The maximum lighting power in watts allowed for the exterior of a building.

Lighting Power Density (LPD): The maximum lighting power per unit area of a building classification of space function.

Low-rise Residential Buildings: Residential occupancy buildings (R-2, R-3, R-4, or R-5) three stories or less in height. (Exception: For purposes of energy conservation, R-1 use group buildings shall be treated as commercial buildings as defined in 780 CMR J2.0.)

Lumen (lm): The luminous flux emitted within a unit solid angle (one steradian) by a point source having a uniform luminous intensity of one cd.

Luminaire: A complete lighting unit consisting of a lamp or lamps together with the housing designed to distribute the light, position and protect the lamps, and connect the lamps to the power supply.

Manufacturer: The company engaged in the original production and assembly of products or equipment or a company that purchases such products and equipment manufactured in accordance with company specifications.

Manual: Capable of being operated by personal intervention (See "Automatic.")

Multi-family dwelling: A building containing three or more dwelling units.

Net Area of Exterior Walls: The gross area of exterior walls, minus the total rough opening area of all windows and doors set in the exterior walls.

Nondepletable Energy Sources: Sources of energy (excluding minerals and solid fuels) derived from incoming solar radiation, including natural daylighting and photosynthetic processes; from phenomena resulting therefrom, including wind, waves and tides, lake or pond thermal differences; and from the internal heat of the earth, including nocturnal thermal exchanges.

Nonrecirculating System: A domestic or service hot water distribution system that is not a recirculating system.

Occupant Sensor: A device that detects the presence or absence of people within an area and causes lighting, equipment, or appliances to be regulated accordingly.

Opaque Areas: All exposed areas of a building envelope which enclose conditioned space, except openings for windows, skylights, doors and building service systems.

Outdoor Air: Air taken from the outdoors, (i.e. - not previously circulated through the HVAC system.)

Packaged Boiler: A boiler that is shipped complete with heating equipment, mechanical draft equipment, and automatic controls; usually shipped in one or more sections.

Plenum: An enclosure that is part of the air distribution system and is distinguished by having almost uniform air pressure. A plenum often is formed in part or in total by portions of the building.

Pool: A body of non-potable water contained in a human-made structure intended and large enough for substantial immersion of one or more people. The term includes but is not limited to swimming pool, whirlpool, spa, hot tub.

Positive Heat Supply: Heat deliberately supplied to a space by design, such as a supply register, radiator or heating element. Also, heat indirectly supplied to a space through uninsulated surfaces of service water heaters and space heating components, such as furnaces, boilers and heating and cooling distribution systems which continually maintain air temperature within the space of 50°F. or higher during normal operation.

Projection Factor (PF): The ratio of the horizontal depth of the external shading projection divided by the sum of the height of the fenestration and the distance from the top of the fenestration to the bottom of the farthest point of the external shading projection, in consistent units.

Proposed Design: A description of the proposed building design used to estimate annual energy costs for determining compliance based on 780 CMR 1309.

Rated R-value of Insulation: The thermal resistance of the insulation alone as specified by the manufacturer according to recognized trade and engineering standards in units of h*ft2*°F/Btu at a mean temperature of 75°F. Rated R-value refers to the thermal resistance of the added insulation in framing cavities or insulated sheathing only and does not include the thermal resistance of other building materials or air films. (See "Thermal resistance.")

Readily Accessible: Capable of being reached quickly for operation, renewal or inspections, without requiring those to whom ready access is requisite to climb over or remove obstacles or to resort to portable ladders or access equipment (see "Accessible.")

Recooling: The removal of heat by sensible cooling of the supply air (directly or indirectly) that has been previously heated above the temperature to which the air is to be supplied to the conditioned space for proper control of the temperature of that space.

Record Drawings: Drawings that record the conditions of the project as constructed. These include any refinements of the construction or bid documents.

Recovered Energy: Energy utilized which would otherwise be wasted (i.e., not contribute to a desired end use) from an energy utilization system.

Reheat: The application of sensible heat to supply air that has been previously cooled below the temperature of the conditioned space by either mechanical refrigeration or the introduction of outdoor air to provide cooling.

Reset: Adjustment of the set point of a control instrument to a higher or lower value automatically or manually to conserve energy.

Roof Assembly: A roof assembly shall be considered as all components of the roof/ceiling envelope through which heat flows, thus creating a building transmission heat loss or gain, where such assembly is exposed to outdoor air and encloses a heated or mechanically cooled space.

The gross area of a roof assembly consists of the total interior surface of such assembly, including skylights exposed to the heated or mechanically cooled space.

Room Cavity Ratio (RCR): A factor that characterizes room configuration as a ratio between the walls and ceiling and is based upon room dimensions.

Sequence: A consecutive series of operations.

Service Systems: All energy-using systems in a building that are operated to provide services for the occupants or processes housed therein, including HVAC, service water heating, illumination, transportation, cooking or food preparation, laundering and similar functions.

Service Water Heating: Supply of hot water for purposes other than space heating.

Setback: Reduction of heating (by reducing the set point) or cooling (by increasing the setpoint) during hours when a building is unoccupied or during periods when lesser demand is acceptable.

Shading Coefficient (SC): The ratio of solar heat gain at normal incidence through glazing to that occurring through ⅛ in. (three mm) thick clear, double-strength glass. Shading coefficient, as used herein, does not include interior, exterior, or integral shading devices.

Slab-on-grade Floor Insulation: Insulation around the perimeter of the floor slab or its supporting foundation when the top edge of the floor perimeter slab is above the finished grade or 12 inches or less below the finished grade.

Solar Energy Source: Source of natural daylighting and of thermal, chemical or electrical energy derived directly from conversion of incident solar radiation.

Solar Heat Gain Coefficient (**SHGC**): The ratio of the solar heat gain entering the space through the fenestration area to the incident solar radiation. Solar heat gain includes directly transmitted solar heat and absorbed solar radiation, which is then reradiated, conducted, or convected into the space. (See fenestration area.)

Standard Design: A version of the proposed design that meets the minimum requirements of 780 CMR 1300 and is used to determine the annual energy usage for determining compliance based on 780 CMR 1309.

System: A combination of central or terminal equipment or components and/or controls, accessories, interconnecting means, and terminal devices by which energy is transformed so as to perform a specific function, such as HVAC, service water heating or illumination.

Thermal Conductance (C): Time rate of heat flow through a body (frequently per unit area) from one of its bounding surfaces to the other for a unit temperature difference between the two surfaces, under steady conditions (Btu/h*ft*2*°F).

Thermal Resistance (R): The reciprocal of thermal conductance (h*ft*2*°F/Btu).

Thermal Resistance, Overall (Ro): The reciprocal of overall thermal conductance (h*ft*2*°F /Btu) [(m2.k)/W]. The overall thermal resistance of the gross area or individual component of the exterior building envelope (roof/ceiling, exterior wall, floor, crawl space wall, foundation, window, skylight, door, or opaque wall, etc.) which includes the weighted R-values of the component assemblies (such as air-film, insulation, drywall, framing, glazing, etc.).

Thermal Transmittance (U): The coefficient of heat transmission (air to air). It is the time rate of heat flow per unit area and unit temperature difference between the warm side and cold side air films (Btu/ h*ft*2*°F). The U-value applies to combinations of different materials used in series along the heat flow path, single materials that comprise a building section, cavity air spaces and surface air films on both sides of a building element. The term F-value applies to U properties for concrete slabs.

Thermal Transmittance, Overall (Uo): The overall (average) heat transmission of a gross area of the exterior building envelope (Btu/ h*ft*2*°F.) The Uo value applies to the combined effect of the time rate of heat flow through the various parallel paths, such as windows, doors and opaque construction areas, comprising the gross area of one or more exterior building components, such as walls, floors or roof/ceilings.

Thermostat: An automatic control device actuated by temperature and designed to be responsive to temperature.

Thermostatic Control: An automatic control device or system used to maintain temperature at a fixed or adjustable set point.

Transformer: A piece of electrical equipment used to convert electric power from one voltage to another voltage.

Dry-type Transformer: A transformer in which the core and coils are in a gaseous or dry compound.

Liquid-immersed Transformer: A transformer in which the core and coils are immersed in an insulating liquid.

Unitary Cooling and Heating Equipment: One or more factory-made assemblies which include an evaporator or cooling coil, a compressor and condenser combination, and may include a heating function as well. When heating and cooling equipment is provided in more than one assembly, the separate assemblies shall be designed to be used together.

Unitary Heat Pump: One or more factory-made assemblies which include an indoor conditioning coil, compressor(s) and outdoor coil or refrigerant-to-water heat exchanger, including means to provide both heating and cooling functions. When heat pump equipment is provided in more than one assembly, the separate assemblies shall be designed to be used together.

Variable Air Volume (VAV) System: HVAC system that controls the dry-bulb temperature within a space by varying the volumetric flow of heated or cooled supply air to the space.

Vent Damper: A device intended for installation in the venting system of an individual, automatically-operated, fossil fuel fired appliance in the outlet or downstream of the appliance draft control device which is designed to automatically open the venting system when the appliance is in operation and to automatically close off the venting system when the appliance is in a standby or shutdown condition.

Ventilation: The process of supplying or removing air by natural or mechanical means to or from any space. Such air may or may not have been conditioned.

Ventilation Air: That portion of supply air which comes from outside (outdoors) plus any recirculated air that has been treated to maintain the desired quality of air within a designated space. (See BOCA Mechanical Code, as listed in *Appendix A*, 780 CMR J3, and definition of "Outdoor air.")

Voltage Drop: A decrease in voltage caused by losses in the lines connecting the power source to the load.

Wall: That portion of the building envelope, including opaque area and fenestration, that is vertical or tilted at an angle of 60° from horizontal or greater. This includes above- and below-grade walls, between floor spandrels, peripheral edges of floors, and foundation walls. For the purposes of determining building envelope requirements, the classifications are defined as follows:

Above-grade Wall: A wall that is not a below-grade wall.

Below-grade Wall: That portion of a wall in the building envelope that is entirely below the finish grade and in contact with the ground.

Metal Building Wall: a wall whose structure consists of metal spanning members supported by steel structural members (i.e., does not include spandrel glass or metal panels in curtain wall systems).

Steel Framed Wall: A wall with a cavity (insulated or otherwise) whose exterior surfaces are separated by steel framing members (i.e., typical steel stud walls and curtain wall systems).

Wood Framed and Other Walls: All other wall types, including wood stud walls.

Wall Area, Gross: The area of the wall measured on the exterior face from the top of the floor to the bottom of the roof.

Water Heater: Closed vessel in which water is heated by the combustion of fuels, electricity, or any other source and is withdrawn for use external to the system at pressures not exceeding 160 psig, including the apparatus by which heat is generated and all controls and devices necessary to prevent water temperatures from exceeding 210°F.

Zone: A space or group of spaces within a building with heating and/or cooling requirements sufficiently similar so that comfort conditions can be maintained throughout by a single controlling device.

780 CMR 1303.0 DESIGN CONDITIONS

1303.1 Scope: 780 CMR 1303.0 applies to all buildings.

1303.2 General: The criteria of 780 CMR 1303.0 establishes the minimum requirements for the thermal design of the exterior envelope of buildings and for HVAC systems and equipment.

1303.3 Design Parameters: The design parameters listed in Tables 1303.1 and 1303.2 shall be used for calculations required under 780 CMR 13.

1303.3.1 Interior Design Conditions: Indoor design temperature and relative humidity shall be determined in accordance with ASHRAE Standard 55-92 listed in *Appendix A*, and shall be selected for minimum total HVAC system energy use in accordance with accepted practice.

Exception: Buildings or portions of buildings which require different temperatures and humidity, such as, but not limited to, hospitals, laboratories, museums, art galleries, supermarkets, thermally sensitive equipment rooms, archival storage facilities, and facilities for the elderly, may require the use of alternative indoor design conditions. Any such use of alternative indoor design conditions shall be documented by a licensed professional.

1303.4 Ventilation: Ventilation air shall conform to the requirements specified in 780 CMR 2801.0.

Table 1303.1
CLIMATE ZONE BY COUNTY

County	Climate Zone #
Barnstable	12a
Berkshire	14a
Bristol	12a
Dukes	12a
Essex	13a
Franklin	14a
Hampden	14a
Hampshire	14a
Middlesex	13a
Nantucket	12a
Norfolk	13a
Plymouth	12a
Suffolk	13a
Worcester	14a

Table 1303.2
CLIMATE ZONE THERMAL DESIGN CRITERIA

Climate Zone #	12a	13a	14a
Heating Degrees (°F) Winter	9	7	-1
Cooling Degrees (°F) Dry Bulb Summer	86	87	86
Cooling Degrees (°F) Wet Bulb Summer	74	74	73
Heating Degree Days Base 65	5884	5641	6894
Heating Degree Days Base 50	2553	2399	3448
Cooling Degree Days Base 65	606	678	507
Cooling Degree Days Base 50	2743	2897	2525
Cooling Degree Hours Base 80	939	1299	409

780 CMR 1304.0 BUILDING ENVELOPE REQUIREMENTS FOR COMMERCIAL AND HIGH RISE RESIDENTIAL BUILDINGS.

1304.1 General: Walls, roof assemblies, floors, glazing, and floor slabs which are part of the building envelope shall meet the requirements of 780 CMR 1304.1, 1304.3, 1304.4 and either:

1. 780 CMR 1304.2, Prescriptive Building Envelope Criteria, provided that:
   a. the building is less than four stories in height above grade;
   b. the vertical fenestration area does not exceed 50% of the gross wall area for each space conditioning category; and,
   c. the skylight fenestration area does not exceed 3% of the gross roof area for each space-conditioning category; or,
2. 780 CMR 1304.5, Building Envelope Trade-off Option.

1304.1.1 Classification of Walls: Walls associated with the building envelope shall be classified in accordance with 780 CMR 1304.1.1.1, 1304.1.1.2 or 1304.1.1.3.

1304.1.1.1 Above-grade Walls: Above-grade walls are those walls covered by 780 CMR 1304.2.1 on the exterior of the building and completely above grade or the above-grade portion of a basement or first-story wall that is more than 15% above grade.

1304.1.1.2 Below-grade Walls: Below-grade walls covered by 780 CMR 1304.2.9 are basement or first-story walls associated with the exterior of the building that are at least 85% below grade.

1304.1.1.3 Interior Walls: Interior walls covered by 780 CMR 1304.2.10 are those walls not on the exterior of the building and that separate conditioned and unconditioned space.

1304.1.2 Moisture Control: The design of buildings for energy conservation shall not create conditions of accelerated deterioration from moisture condensation.

A vapor barrier having a maximum permeability of zero point one (0.1) perm or less (equivalent to a 4 mil polyethylene sheet) shall be installed on the winter warm side of walls, ceilings and floors enclosing a conditioned space. Batt/blanket insulation with a vapor barrier attached shall be attached to the winter warm sides or faces of wall studs, sole plates, top plates, lintels and headers at intervals of eight inches on center to prevent convection loops through the insulation. Where batt/blanket insulation is of a "friction fit" design and a sheet vapor barrier is employed, the vapor barrier shall be affixed to the interior face of the wall studs, sole plates, top plates, lintels and headers winter warm side in accordance with the vapor barrier manufacturer's recommendations. All joints, holes, imperfections and penetrations of the vapor barrier shall be taped tight with a vapor barrier tape recommended by the vapor barrier manufacturer.

All other envelope building materials and finishes installed towards the cooler, exterior side of the wall shall have water vapor permeability at least ten times greater than the interior vapor barrier material.

Exception 1: Materials to the exterior of a ventilated rainscreen cavity may have any permeability.

Exception 2: Envelope systems that maintain the temperature of potential condensing surfaces (typically the interface of exterior sheathing with cavity insulation) above the dewpoint temperature of the interior air. For calculation purposes use Chapter 22 in 1997 ASHRAE Fundamentals Handbook, "Steady State Design Tools." Assume steady-state heat transfer, interior air temperature and humidity specified in 780 CMR 1303.3, and exterior air temperature indicated as "Heating Degrees Winter" in Table 1303.2.

Exception 3: Envelope systems that maintain the moisture content of all building materials that comprise the assembly below the equilibrium moisture content the materials would achieve when exposed to relative humidity of 80%. For calculation purposes use Chapter 22 in 1997 ASHRAE Fundamentals Handbook, "Mathematical Models". Assume interior air temperature and humidity specified in 780 CMR 1303.3.

Buildings with unusual interior design conditions (such as continually refrigerated buildings, ice rinks, cold storage) shall demonstrate compliance by the method in Exception 3.

1304.2 Prescriptive Building Envelope Criteria: The building envelope components shall meet each of the applicable requirements in Tables 1304.2.1-12, based on the climate zone and the percentage of wall that is glazed. The climate zone shall be determined based on the county in accordance with 780 CMR 1302, Tables 1302.1 and 1302.2. The percentage of wall that is glazed shall be determined by dividing the aggregate area of rough openings or unit dimensions for fenestration (windows and glazed doors) in all the above grade walls associated with the building envelope by the total gross area of all above grade exterior walls that are part of the building envelope. In buildings with multiple types of building envelope construction, each building envelope construction type shall be evaluated separately.

1304.2.1 Above Grade Walls: The minimum thermal resistance (R-value) of the insulating material installed in the wall cavity between the framing members and continuously on the walls shall be as specified in Tables 1304.2.1-12 based on framing type and construction materials used in the wall assembly. Where both cavity and continuous insulation values are provided in Tables 1304.2.1-12, both requirements shall be met. Masonry walls shall be considered "framed walls" when weighing less than 35 psf of wall area.

1304.2.2 Non-glazed Doors: The minimum thermal resistance (R-value) of non-glazed doors, excluding air films, shall be as follows: opaque doors R- 0.7; overhead doors R- 1.45; air-lock entry door R- 0.5; and revolving door R- 0.5. When the total area of non-glazed doors is greater than 5% of the total opaque wall area, the area of non-glazed doors above 5% shall be insulated as an opaque wall or an adjustment shall be made in the thermal resistance of the wall to address any thermal deficiency created by the doors.

1304.2.3 Windows and Glass Doors: The maximum solar heat gain coefficient (SHGC) and thermal transmittance (U-value) of window assemblies and glass doors located in the building envelope shall be as specified in Tables 1304.2.1-12 based on the window projection factor.

The window projection factor shall be determined in accordance with equation 1304.2.3.

Equation 1304.2.3

$$PF = A/B$$

Where:

PF= Projection factor (decimal).

A = Distance measured horizontally from the extremity of any overhang, eave, or permanently attached shading device to the vertical surface of the glazing.

B = Distance measured vertically from the bottom of the glazing to the underside of the overhang, eave, or permanently attached shading device.

Where different windows or glass doors have different PF values they shall each be evaluated separately or an area weighted PF value shall be calculated and used for all windows and glass doors.

1304.2.4 Roof Assembly: The minimum thermal resistance (R-value) of the insulating material installed either between the roof framing or continuously on the roof assembly shall be as specified in Tables 1304.2.1-12 based on construction materials used in the roof assembly.

1304.2.5 Skylights: Skylights located in the building envelope shall be limited to 3% of the gross roof assembly area and shall have a maximum thermal transmittance (U-value) of the skylight assembly as specified in Tables 1304.2.1-12.

1304.2.6 Floors Over Outdoor Air or Unconditioned Space: The minimum thermal resistance (R-value) of the insulating material installed either between the floor framing or continuously on the floor assembly shall be as specified in Tables 1304.2.1-12 based on construction materials used in the floor assembly.

1304.2.7 Slabs on Grade: The minimum thermal resistance (R-value) of the insulation around the perimeter of the slab floor on grade shall be R-5. The insulation shall be placed on the outside of the foundation or on the inside of a foundation wall. Insulation on the outside of the foundation wall shall extend downward from the top of the slab for a minimum of 48 in. Insulation on the inside of the foundation wall shall extend downward to at least the bottom of the slab and then horizontally for a minimum total distance of 48 in. In addition, the entire area of the slab on grade shall be insulated with a minimum of R-5 rigid insulation in the following buildings: buildings of use group E, including daycare; buildings of use groups R-1, R-2, I-1 and I-2, and; college and university buildings of B and A use groups.

Exception: For a monolithic slab on grade floor, the insulation shall extend from the top of the slab on grade to the bottom of the footing. Continuous under-slab insulation shall be provided per 1304.2.8.

1304.2.8 Slabs Below Grade: The entire area of a floor slab which is below grade and is in contact with the ground shall be insulated with a minimum of R-5 rigid insulation in the following buildings: buildings of use group E, including daycare; buildings of use groups R-1, R-2, I-1 and I-2, and; college and university buildings of B and A use groups.

1304.2.9 Below Grade Walls: The minimum thermal resistance of the insulating material installed in, or continuously on, the below grade walls shall be R-5, and shall extend from the top of the wall to a depth of ten ft. below the outside finish ground level, or to the depth of the bottom of the floor slab, whichever is greater.

1304.2.10 Interior Walls: The minimum thermal resistance (R-value) of the insulating material installed in the wall cavity or continuously on the interior walls separating *conditioned space* from *unconditioned space* shall be as specified in Tables 1304.2.1, 1304.2.5, and 1304.2.9 for above grade walls, regardless of glazing area, based on framing type and construction materials used in the wall assembly.

TABLE 1304.2.1
BUILDING ENVELOPE REQUIREMENTS
Climate Zone 12a
Glazing Area 10% or less of Above Grade Wall Area

Above-Grade Walls:	Continuous Insulation (or average insulation value)*	Metal Framing (c.i. = continuous insulation)	Wood Framing
Framed or Masonry < 35 psf.	R-7	R-11 + R-3 c.i.	R-11
Masonry ≥ 35 psf.	R-5	R-11 + R-3 c.i.	R-11

Window Assemblies:	SHGC (maximum)	U-Value (maximum)
PF < 0.25	Any	Any
0.25 ≤ PF < 0.50	Any	Any
PF ≥ 0.50	Any	Any
Skylights - U-Value (maximum)	X	0.8

Roof Assemblies: (either/or)	Insulation Between Framing	Continuous Insulation
All-Wood Joist/Truss	R-19	R-16
Non-wood Joist/Truss	R-25	R-17
Concrete Slab or Deck	NA	R-16
Metal Purlin with Thermal Break	R-25	R-17
Metal Purlin w/o Thermal Break	X	R-17

Floor Assemblies: (either/or)	Insulation Between Framing	Continuous Insulation
All-Wood Joist/Truss	R-19	R-16
Non-wood Joist/Truss	R-19	R-16
Concrete Slab or Deck	NA	R-16
Slab, Perimeter, Below-Grade Wall	R-5	

* For masonry walls, average R-value shall be calculated based on the assumption of isothermal planes, using methodology in 1997 ASHRAE Fundamentals Handbook, Chapter 22.

TABLE 1304.2.2
BUILDING ENVELOPE REQUIREMENTS
Climate Zone 12a
Glazing Area Over 10% but not greater than 25% of Above Grade Wall Area

Above-Grade Walls:	Continuous Insulation (or average insulation value)*	Metal Framing (c.i. = continuous insulation)	Wood Framing
Framed or Masonry < 35 psf.	R-7	R-11 + R-3 c.i.	R-11
Masonry ≥ 35 psf.	R-5	R-11 + R-3 c.i.	R-11

Window Assemblies:	SHGC (maximum)	U-Value (maximum)
PF < 0.25	0.6	0.6
0.25 ≤ PF < 0.50	0.7	0.6
PF ≥ 0.50	Any	0.6
Skylights - U-Value (maximum)	X	0.8

Roof Assemblies: (either/or)	Insulation Between Framing	Continuous Insulation
All-Wood Joist/Truss	R-25	R-19
Non-wood Joist/Truss	R-25	R-20
Concrete Slab or Deck	NA	R-19
Metal Purlin with Thermal Break	R-30	R-20
Metal Purlin w/o Thermal Break	X	R-20

Floor Assemblies: (either/or)	Insulation Between Framing	Continuous Insulation
All-Wood Joist/Truss	R-19	R-16
Non-wood Joist/Truss	R-19	R-16
Concrete Slab or Deck	NA	R-16
Slab, Perimeter, Below-Grade Wall	R-5	

TABLE 1304.2.3
BUILDING ENVELOPE REQUIREMENTS
Climate Zone 12a
Glazing Area Over 25% but not greater than 40% of Above Grade Wall Area

Above-Grade Walls:	Continuous Insulation (or average insulation value)*	Metal Framing (c.i. = continuous insulation)	Wood Framing
Framed or Masonry < 35 psf.	R-7	R-11 + R-3 c.i.	R-11
Masonry ≥ 35 psf.	R-5	R-11 + R-3 c.i.	R-11

Window Assemblies:	SHGC (maximum)	U-Value (maximum)
PF < 0.25	0.5	0.5
0.25 ≤ PF < 0.50	0.6	0.5
PF ≥ 0.50	0.7	0.5
Skylights - U-Value (maximum)	X	0.8

Roof Assemblies: (either/or)	Insulation Between Framing	Continuous Insulation
All-Wood Joist/Truss	R-30	R-23
Non-wood Joist/Truss	R-30	R-24
Concrete Slab or Deck	NA	R-23
Metal Purlin with Thermal Break	X	R-24
Metal Purlin w/o Thermal Break	X	R-24

Floor Assemblies: (either/or)	Insulation Between Framing	Continuous Insulation
All-Wood Joist/Truss	R-19	R-16
Non-wood Joist/Truss	R-19	R-16
Concrete Slab or Deck	NA	R-16
Slab, Perimeter, Below-Grade Wall	R-5	

* For masonry walls, average R-value shall be calculated based on the assumption of isothermal planes, using methodology in 1997 ASHRAE Fundamentals Handbook, Chapter 22.

TABLE 1304.2.4
BUILDING ENVELOPE REQUIREMENTS
Climate Zone 12a
Glazing Area Over 40% but not greater than 50% of Above Grade Wall Area

Above-Grade Walls:	Continuous Insulation (or average insulation value)*	Metal Framing (c.i. = continuous insulation)	Wood Framing
Framed or Masonry < 35 psf.	R-7	R-13 + R-3 c.i.	R-11
Masonry ≥ 35 psf.	R-5	R-11 + R-3 c.i.	R-11

Window Assemblies:	SHGC (maximum)	U-Value (maximum)
PF < 0.25	0.4	0.4
0.25 ≤ PF < 0.50	0.5	0.4
PF ≥ 0.50	0.7	0.4
Skylights - U-Value (maximum)	X	0.8

Roof Assemblies: (either/or)	Insulation Between Framing	Continuous Insulation
All-Wood Joist/Truss	R-30	R-23
Non-wood Joist/Truss	R-30	R-24
Concrete Slab or Deck	NA	R-23
Metal Purlin with Thermal Break	R-30	R-24
Metal Purlin w/o Thermal Break	R-38	R-24

Floor Assemblies: (either/or)	Insulation Between Framing	Continuous Insulation
All-Wood Joist/Truss	R-19	R-16
Non-wood Joist/Truss	R-19	R-16
Concrete Slab or Deck	NA	R-16
Slab, Perimeter, Below-Grade Wall	R-5	

TABLE 1304.2.5
BUILDING ENVELOPE REQUIREMENTS
Climate Zone 13a
Glazing Area 10% or less of Above Grade Wall Area

Above-Grade Walls:	Continuous Insulation (or average insulation value)*	Metal Framing (c.i. = continuous insulation)	Wood Framing
Framed or Masonry < 35 psf.	R-7	R-13 + R-3 c.i.	R-11
Masonry ≥ 35 psf.	R-5	R-11 + R-3 c.i.	R-11

Window Assemblies:	SHGC (maximum)	U-Value (maximum)
PF < 0.25	Any	0.7
0.25 ≤ PF < 0.50	Any	0.7
PF ≥ 0.50	Any	0.7
Skylights - U-Value (maximum)	X	0.8

Roof Assemblies: (either/or)	Insulation Between Framing	Continuous Insulation
All-Wood Joist/Truss	R-19	R-14
Non-wood Joist/Truss	R-19	R-15
Concrete Slab or Deck	NA	R-14
Metal Purlin with Thermal Break	R-25	R-15
Metal Purlin w/o Thermal Break	X	R-15

Floor Assemblies: (either/or)	Insulation Between Framing	Continuous Insulation
All-Wood Joist/Truss	R-19	R-16
Non-wood Joist/Truss	R-25	R-17
Concrete Slab or Deck	NA	R-17
Slab, Perimeter, Below-Grade Wall	R-5	

* For masonry walls, average R-value shall be calculated based on the assumption of isothermal planes, using methodology in 1997 ASHRAE Fundamentals Handbook, Chapter 22.

TABLE 1304.2.6
BUILDING ENVELOPE REQUIREMENTS
Climate Zone 13a
Glazing Area Over 10% but not greater than 25% of Above Grade Wall Area

Above-Grade Walls:	Continuous Insulation (or average insulation value)*	Metal Framing (c.i. = continuous insulation)	Wood Framing
Framed or Masonry < 35 psf.	R-7	R-13 + R-3 c.i.	R-11
Masonry ≥ 35 psf.	R-5	R-11 + R-3 c.i.	R-11

Window Assemblies:	SHGC (maximum)	U-Value (maximum)
PF < 0.25	0.6	0.6
0.25 ≤ PF < 0.50	0.7	0.6
PF ≥ 0.50	Any	0.6
Skylights - U-Value (maximum)	X	0.8

Roof Assemblies: (either/or)	Insulation Between Framing	Continuous Insulation
All-Wood Joist/Truss	R-25	R-19
Non-wood Joist/Truss	R-25	R-20
Concrete Slab or Deck	NA	R-19
Metal Purlin with Thermal Break	R-30	R-20
Metal Purlin w/o Thermal Break	X	R-20

Floor Assemblies: (either/or)	Insulation Between Framing	Continuous Insulation
All-Wood Joist/Truss	R-19	R-16
Non-wood Joist/Truss	R-25	R-17
Concrete Slab or Deck	NA	R-17
Slab, Perimeter, Below-Grade Wall	R-5	

TABLE 1304.2.7
BUILDING ENVELOPE REQUIREMENTS
Climate Zone 13a
Glazing Area Over 25% but not greater than 40% of Above Grade Wall Area

Above-Grade Walls:	Continuous Insulation (or average insulation value)*	Metal Framing (c.i. = continuous insulation)	Wood Framing
Framed or Masonry < 35 psf.	R-7	R-13 + R-3 c.i.	R-11
Masonry ≥ 35 psf.	R-5	R-11 + R-3 c.i.	R-11

Window Assemblies:	SHGC (maximum)	U-Value (maximum)
PF < 0.25	0.5	0.5
0.25 ≤ PF < 0.50	0.6	0.5
PF ≥ 0.50	0.7	0.5
Skylights - U-Value (maximum)	X	0.8

Roof Assemblies: (either/or)	Insulation Between Framing	Continuous Insulation
All-Wood Joist/Truss	R-30	R-23
Non-wood Joist/Truss	R-30	R-24
Concrete Slab or Deck	NA	R-23
Metal Purlin with Thermal Break	X	R-24
Metal Purlin w/o Thermal Break	X	R-24

Floor Assemblies: (either/or)	Insulation Between Framing	Continuous Insulation
All-Wood Joist/Truss	R-19	R-16
Non-wood Joist/Truss	R-25	R-17
Concrete Slab or Deck	NA	R-17
Slab, Perimeter, Below-Grade Wall	R-5	

* For masonry walls, average R-value shall be calculated based on the assumption of isothermal planes, using methodology in 1997 ASHRAE Fundamentals Handbook, Chapter 22.

TABLE 1304.2.8
BUILDING ENVELOPE REQUIREMENTS
Climate Zone 13a
Glazing Area Over 40% but not greater than 50% of Above Grade Wall Area

Above-Grade Walls:	Continuous Insulation (or average insulation value)*	Metal Framing (c.i. = continuous insulation)	Wood Framing
Framed or Masonry < 35 psf.	R-7	R-13 + R-3 c.i.	R-11
Masonry ≥ 35 psf.	R-5	R-11 + R-3 c.i.	R-11

Window Assemblies:	SHGC (maximum)	U-Value (maximum)
PF < 0.25	0.4	0.4
0.25 ≤ PF < 0.50	0.5	0.4
PF ≥ 0.50	0.7	0.4
Skylights - U-Value (maximum)	X	0.8

Roof Assemblies: (either/or)	Insulation Between Framing	Continuous Insulation
All-Wood Joist/Truss	R-30	R-23
Non-wood Joist/Truss	R-30	R-24
Concrete Slab or Deck	NA	R-23
Metal Purlin with Thermal Break	R-30	R-24
Metal Purlin w/o Thermal Break	R-38	R-24

Floor Assemblies: (either/or)	Insulation Between Framing	Continuous Insulation
All-Wood Joist/Truss	R-19	R-16
Non-wood Joist/Truss	R-25	R-17
Concrete Slab or Deck	NA	R-17
Slab, Perimeter, Below-Grade Wall	R-5	

TABLE 1304.2.9
BUILDING ENVELOPE REQUIREMENTS
Climate Zone 14a
Glazing Area 10% or less of Above Grade Wall Area

Above-Grade Walls:	Continuous Insulation (or average insulation value)*	Metal Framing (c.i. = continuous insulation)	Wood Framing
Framed or Masonry < 35 psf.	R-7	R-11 + R-3 c.i.	R-11
Masonry ≥ 35 psf.	R-5	R-11 + R-3 c.i.	R-11

Window Assemblies:	SHGC (maximum)	U-Value (maximum)
PF < 0.25	Any	0.7
0.25 ≤ PF < 0.50	Any	0.7
PF ≥ 0.50	Any	0.7
Skylights - U-Value (maximum)	X	0.8

Roof Assemblies: (either/or)	Insulation Between Framing	Continuous Insulation
All-Wood Joist/Truss	R-19	R-17
Non-wood Joist/Truss	R-25	R-18
Concrete Slab or Deck	NA	R-17
Metal Purlin with Thermal Break	R-30	R-18
Metal Purlin w/o Thermal Break	X	R-18

Floor Assemblies: (either/or)	Insulation Between Framing	Continuous Insulation
All-Wood Joist/Truss	R-25	R-18
Non-wood Joist/Truss	R-25	R-19
Concrete Slab or Deck	NA	R-19
Slab, Perimeter, Below-Grade Wall	R-5	

* For masonry walls, average R-value shall be calculated based on the assumption of isothermal planes, using methodology in 1997 ASHRAE Fundamentals Handbook, Chapter 22.

TABLE 1304.2.10
BUILDING ENVELOPE REQUIREMENTS
Climate Zone 14a
Glazing Area Over 10% but not greater than 25% of Above Grade Wall Area

Above-Grade Walls:	Continuous Insulation (or average insulation value)*	Metal Framing (c.i. = continuous insulation)	Wood Framing
Framed or Masonry < 35 psf.	R-7	R-13 + R-3 c.i.	R-11
Masonry ≥ 35 psf.	R-5	R-11 + R-3 c.i.	R-11

Window Assemblies:	SHGC (maximum)	U-Value (maximum)
PF < 0.25	0.5	0.6
0.25 ≤ PF < 0.50	0.6	0.6
PF ≥ 0.50	0.7	0.6
Skylights - U-Value (maximum)	X	0.8

Roof Assemblies: (either/or)	Insulation Between Framing	Continuous Insulation
All-Wood Joist/Truss	R-25	R-19
Non-wood Joist/Truss	R-25	R-20
Concrete Slab or Deck	NA	R-19
Metal Purlin with Thermal Break	R-30	R-20
Metal Purlin w/o Thermal Break	X	R-20

Floor Assemblies: (either/or)	Insulation Between Framing	Continuous Insulation
All-Wood Joist/Truss	R-25	R-18
Non-wood Joist/Truss	R-25	R-19
Concrete Slab or Deck	NA	R-19
Slab, Perimeter, Below-Grade Wall	R-5	

TABLE 1304.2.11
BUILDING ENVELOPE REQUIREMENTS
Climate Zone 14a
Glazing Area Over 25% but not greater than 40% of Above Grade Wall Area

Above-Grade Walls:	Continuous Insulation (or average insulation value)*	Metal Framing (c.i. = continuous insulation)	Wood Framing
Framed or Masonry < 35 psf.	R-7	R-13 + R-3 c.i.	R-11
Masonry ≥ 35 psf.	R-5	R-11 + R-3 c.i.	R-11

Window Assemblies:	SHGC (maximum)	U-Value (maximum)
PF < 0.25	0.4	0.5
0.25 ≤ PF < 0.50	0.5	0.5
PF ≥ 0.50	0.6	0.5
Skylights - U-Value (maximum)	X	0.8

Roof Assemblies: (either/or)	Insulation Between Framing	Continuous Insulation
All-Wood Joist/Truss	R-30	R-23
Non-wood Joist/Truss	R-30	R-24
Concrete Slab or Deck	NA	R-23
Metal Purlin with Thermal Break	X	R-24
Metal Purlin w/o Thermal Break	X	R-24

Floor Assemblies: (either/or)	Insulation Between Framing	Continuous Insulation
All-Wood Joist/Truss	R-25	R-18
Non-wood Joist/Truss	R-25	R-19
Concrete Slab or Deck	NA	R-19
Slab, Perimeter, Below-Grade Wall	R-5	

* For masonry walls, average R-value shall be calculated based on the assumption of isothermal planes, using methodology in 1997 ASHRAE Fundamentals Handbook, Chapter 22.

TABLE 1304.2.12
BUILDING ENVELOPE REQUIREMENTS
Climate Zone 14a
Glazing Area Over 40% but not greater than 50% of Above Grade Wall Area

Above-Grade Walls:	Continuous Insulation (or average insulation value)*	Metal Framing (c.i. = continuous insulation)	Wood Framing
Framed or Masonry < 35 psf.	R-7	R-13 + R-3 c.i.	R-11
Masonry ≥ 35 psf.	R-5	R-11 + R-3 c.i.	R-11

Window Assemblies:	SHGC (maximum)	U-Value (maximum)
PF < 0.25	0.4	0.4
0.25 ≤ PF < 0.50	0.5	0.4
PF ≥ 0.50	0.6	0.4
Skylights - U-Value (maximum)	X	0.8

Roof Assemblies: (either/or)	Insulation Between Framing	Continuous Insulation
All-Wood Joist/Truss	R-30	R-23
Non-wood Joist/Truss	R-30	R-24
Concrete Slab or Deck	NA	R-23
Metal Purlin with Thermal Break	R-38	R-24
Metal Purlin w/o Thermal Break	R-38	R-24

Floor Assemblies: (either/or)	Insulation Between Framing	Continuous Insulation
All-Wood Joist/Truss	R-25	R-18
Non-wood Joist/Truss	R-25	R-19
Concrete Slab or Deck	NA	R-19
Slab, Perimeter, Below-Grade Wall	R-5	

* For masonry walls, average R-value shall be calculated based on the assumption of isothermal planes, using methodology in 1997 ASHRAE Fundamentals Handbook, Chapter 22.

1304.3 Air Leakage

1304.3.1 Air Barriers: The building envelope shall be designed and constructed with a continuous air barrier to control air leakage into, or out of the conditioned space. An air barrier shall also be provided for interior partitions between conditioned space and space designed to maintain temperature or humidity levels which differ from those in the conditioned space by more than 50% of the difference between the conditioned space and design ambient conditions. The air barrier shall have the following characteristics:

1. It must be continuous, with all joints made air-tight.
2. It shall have an air permeability not to exceed 0.004 cfm/ft^2 under a pressure differential of 0.3 in. water.
3. It shall be capable of withstanding positive and negative combined design wind, fan and stack pressures on the envelope without damage or displacement, and shall transfer the load to the structure. It shall not displace adjacent materials under full load.
4. It shall be durable or maintainable.
5. The air barrier shall be joined in an air-tight and flexible manner to the air barrier material of adjacent systems, allowing for the relative movement of systems due to thermal and moisture variations and creep. Connection shall be made between:
   a. Foundation and walls.
   b. Walls and windows or doors.
   c. Different wall systems.
   d. Wall and roof.
   e. Wall and roof over unconditioned space.
   f. Walls, floor and roof across construction, control and expansion joints.
   g. Walls, floors and roof to utility, pipe and duct penetrations.

1304.3.2 Air Barrier Penetrations: All penetrations of the air barrier and paths of air infiltration/exfiltration shall be made air-tight.

1304.3.3 Fenestration and Doors: Air leakage for *fenestration* and *doors* shall be determined in accordance with NFRC 400 Air leakage shall be determined by an independent laboratory accredited by a nationally recognized accreditation organization and shall be certified by the manufacturer. Air leakage shall not exceed 1.0 cfm/ft^2 for glazed swinging entrance doors and for revolving doors, and 0.4 cfm/ft^2 for all other products under a pressure differential of 0.3 inches of water.

Exceptions:

1. Field fabricated *fenestration* and *doors* that are weather-stripped.
2. For garage *doors*, air leakage determined by test at standard test conditions in accordance with NAGDM 105 shall be an acceptable alternate for compliance with air leakage requirements.
3. Until December 31, 1999, air leakage determined by test at standard test conditions in accordance with ASTM E283 shall be an acceptable alternate for compliance with air leakage requirements. This exception shall cease to exist on January 1, 2000.

1304.3.4 Stairwell and Elevator Lobby Doors: Stairwell and elevator lobby doors shall meet the requirements of 780 CMR 1304.3.3. Such doors shall be equipped with weatherseals.

1304.3.5 Loading Dock Weatherseals: Cargo *doors* and loading dock *doors* shall be equipped with weatherseals to restrict *infiltration* when vehicles are parked in the doorway.

1304.3.6 Vestibules: A *door* that separates *conditioned space* from the exterior shall be protected with an enclosed vestibule, with all *doors* opening into and out of the vestibule equipped with self-closing devices. Vestibules shall be designed so that in passing through the vestibule it is not necessary for the interior and exterior *doors* to open at the same time. Interior and exterior *doors* shall have a minimum distance between them of not less than seven ft (2.1 m) when in the closed position.

Exceptions:

1. *doors* not intended to be used as a *building entrance door*, such as doors for mechanical or electrical equipment rooms;
2. *doors* opening directly from a *dwelling unit*;
3. *doors* that open directly from a space less than 2000 ft^2 (200 m^2) in area
4. revolving *doors* or *doors* adjacent to revolving *doors*;
5. *doors* used primarily to facilitate vehicular movement or material handling and adjacent personnel *doors*.

1304.3.7 Air-tight Dampers: Air-tight operable dampers shall be installed where the air barrier is penetrated by:

1. fixed open louvers such as in elevator shafts and machine rooms;
2. mechanical system components which allow infiltration or exfiltration of air when the systems are inactive, such as atrium smoke exhaust systems and make-up air louvers;
3. outside air intakes, exhaust outlets, relief outlets, stair shaft, elevator shaft smoke relief openings, and other similar elements.

Such dampers shall have a leakage no greater than 3cfm/ft^2 at 1.0 in w.g. when tested in accordance with AMCA Standard 500. They shall be set in the closed position, and shall automatically open upon:

1. the activation of any fire alarm initiating device of the building's fire alarm system;
2. the interruption of power to the damper.

1304.3.8 Recessed Lighting Fixtures: When installed in the building envelope, recessed lighting fixtures shall meet one of the following requirements:

1. Type IC rated, manufactured with no penetrations between the inside of the recessed fixture and ceiling cavity and sealed or gasketed to prevent air leakage into the unconditioned space.
2. Type IC rated, in accordance with ASTM E 283 no more than 2.0 cfm air movement from the conditioned space to the ceiling cavity. The lighting fixture shall be tested at 75 Pa or 1.57 lbs./ft.^{2} pressure difference and shall be labeled.

1304.3.9 Envelope Gaps and Cavities: All gaps and cavities between rough framing and door and window heads, jambs, and sills shall be made air-tight, filled with insulation and covered with a vapor barrier meeting the criteria for vapor barriers.

1304.4 Insulation General: Where insulation is required in 780 CMR 1304.2 or 780 CMR 1304.5, it shall also comply with 780 CMR 1304.4.1 through 1304.4.5.

1304.4.1 Insulation Installation: Insulation materials shall be installed in accordance with manufacturer's recommendations as to achieve and maintain *rated R-value of insulation*.

Where continuous wall insulation is required in 780 CMR 1304.2 or 780CMR 1304.5 in multi-story buildings, the insulation must be continuous across floor structures.

Open-blown or poured loose-fill insulation shall not be used in *attic roof* spaces with eave vents when the slope of the ceiling is more than three in 12 unless special provisions are made to prevent settling and maintain an air space for ventilation above the insulation. Baffling of the vent openings shall be provided to deflect the incoming air above the surface of the insulation.

1304.4.2 Substantial Contact: Insulation shall be installed in a permanent manner in *substantial contact* with adjacent surfaces in a manner which will prevent convection of air around the insulation. Flexible batt insulation installed in floor cavities shall be supported in a permanent manner by supports no greater than 24 in. on center.

Batt insulation with integral vapor barrier shall be attached to the winter warm sides or faces of wall studs, sole plates, top plates, lintels and headers at intervals of eight inches on center. Where batt/blanket insulation is of a "friction fit" design and a poly vapor barrier is employed, the vapor barrier shall be affixed to the interior face of the wall studs, sole plates, top plates, lintels and headers (winter warm side) in accordance with the insulation manufacturer's recommendations.

1304.4.3 Recessed Equipment: Lighting fixtures; heating, ventilating, and air-conditioning equipment, including wall heaters, ducts, and plenums; and other equipment shall not be recessed in such a manner to affect the insulation thickness unless:

1. the total combined area affected (including necessary clearances) is less than one percent of the opaque area of the assembly, or
2. the entire *roof*, *wall*, or *floor* is covered with insulation to the full depth required or
3. the effects of reduced insulation are included in calculations using an area weighted average method and compressed insulation values from the ASHRAE 1997 Handbook of Fundamentals. In all cases, air leakage through the recessed equipment to the *conditioned space* shall be prevented.

1304.4.4 Location of Roof Insulation: The *roof* shall be insulated in a location other than directly on a suspended ceiling with removable ceiling panels.

1304.4.5 Insulation Protection: Exterior insulation shall be covered with a protective material to prevent damage from sunlight, moisture, landscaping operations, equipment maintenance, and wind. In *attics* and mechanical rooms, a way to access equipment that prevents damaging or compressing the insulation shall be provided. Foundation vents shall not interfere with the insulation.

Insulation materials in ground contact shall have a water absorption rate no greater than 0.3% when tested in accordance with ASTM C272.

Exception: Insulation materials that have a water drainage system included.

1304.5 Building Envelope Trade-Off Option: The *building envelope* complies with the standard if the proposed building satisfies the provisions of 780 CMR 1304.1, 780 CMR 1304.3, and 780 CMR 1304.4, and the *envelope performance factor* of the proposed building is less than or equal to the *envelope performance factor* of the budget building. The *envelope performance factor* considers only the *building envelope* components. Schedules of operation, lighting power, equipment power, occupant density, and mechanical systems shall be the same for both the proposed building and the budget building. *Envelope performance factor* shall be calculated using computer programs accepted by the Board of Building Regulations and Standards.

780 CMR 1305.0 HEATING VENTILATION AND AIR CONDITIONING

1305.1 General: 780 CMR 1305.0 covers the design and construction of mechanical systems and equipment serving the building heating, cooling, or ventilating needs.

1305.1.1 Compliance: Compliance with 780 CMR 1305.0 shall be achieved by meeting either 780 CMR 1305.2 or 780 CMR 1305.3.

1305.2 Simple HVAC Systems and Equipment:

1305.2.1 Scope: 780 CMR 1305.2 applies to buildings served by unitary or packaged air conditioners or heat pumps, packaged terminal air conditioners, and packaged furnaces each serving one zone and controlled by a single thermostatic control in the zone served. It also applies to buildings served by packaged boilers and two-pipe heating systems serving one or more zones.

780 CMR 1305.2 does not apply to non-unitary or non-packaged HVAC equipment and systems or to chiller systems.

780 CMR 1305.2 does not apply to buildings in which the outside air quantity capable of being supplied by any individual fan system exceeds 3000 cfm or 70% of the total design supply air quantity for the fan system.

1305.2.2 Calculation of Heating and Cooling Loads: Design loads shall be determined in accordance with the procedures described in Chapters 25 and 26 of the ASHRAE 1997 Handbook of Fundamentals or an approved equivalent computation procedure.

1305.2.2.1 Equipment and System Sizing: Heating and cooling equipment and systems capacity shall not exceed the loads calculated in accordance with 780 CMR 1305.2.2. A single piece of equipment providing both heating and cooling shall satisfy this provision for one function with the capacity for the other function as small as possible, within available equipment options.

1305.2.3 HVAC Equipment Performance Requirements: Packaged air conditioners and heat pumps with capacity greater than 240,000 Btu/h, ground-source and ground water source heat pumps, and duct furnaces and unit heaters shall meet the minimum efficiency requirements of Tables 1305.3.3a, b, and d, when tested and rated in accordance with the referenced test procedure. The efficiency shall be verified through data furnished by the manufacturer or through certification under an approved certification program. Where multiple rating conditions and/or performance requirements are provided, the equipment shall satisfy all stated requirements.

Other new equipment within the scope of 780 CMR 1305.2 is required to meet efficiency standards administered by the federal government. The efficiency of used equipment within the scope of the federal standards shall be verified through data furnished by the manufacturer.

Equipment not required to meet efficiency standards administered by the federal government, and not in Tables 1305.3.3a, b, and d may be used, and have no minimum performance requirements.

1305.2.4 Temperature and Humidity Controls:

1305.2.4.1 Temperature Controls: Each heating and cooling system shall have at least one programmable thermostat. The thermostat shall have the capability to setback or shutdown the system based on day of the week and time of day and a readily accessible manual override that will return to the pre-setback or shutdown schedule without reprogramming. Thermostatic controls shall be capable of providing a temperature range or dead band of at least 5°F within which the supply of heating and cooling energy to the zone is shut off or reduced to a minimum.

Exception: Thermostats requiring manual changeover between heating and cooling modes.

Where heating and cooling to a zone are controlled by separate zone thermostatic controls located within the zone, means (such as limit switches, mechanical stops, or, for *direct digital control* (DDC) systems, software programming) shall be provided to prevent the heating set point from exceeding the cooling set point minus any applicable proportional band.

Heat pumps having supplementary electric resistance heat shall have controls that, except during defrost, prevent supplemental heat operation when the heat pump can meet the heating load.

1305.2.4.2 Humidity Controls: When humidistats are installed they shall prevent the use of fossil fuel or electric power to achieve a humidity below 60% when the system controlled is cooling, and above 30% when the system controlled is heating.

1305.2.5 Hydronic System Controls: Hydronic heating systems of at least 300,000 Btu/h design capacity supplying heated water to comfort conditioning systems shall include controls that have the capability to automatically reset the supply water temperatures by representative building loads (including return water temperature) or by outside air temperature.

Exception: systems which vary water flow in compliance with 780 CMR 1305.3.5.4.

Hydronic heating systems comprised of multiple packaged boilers and designed to deliver conditioned water or steam into a common distribution system shall include automatic controls capable of sequencing operation of the boilers.

Hydronic heating systems comprised of a single boiler of greater than 500,000 Btu/h design capacity shall include either a multi-staged or modulating burner.

1305.2.6 Ventilation: Natural or mechanical ventilation shall be provided in accordance with the mechanical code listed in *Appendix A*. Any mechanical ventilation system shall have the capability to reduce the outdoor air supply to the minimum required by the mechanical code listed in *Appendix A*.

1305.2.6.1 Distributed Fan Systems: Where mechanical ventilation is provided by multiple fan systems located in a plenum or other enclosed space, outdoor air shall be ducted directly to each individual fan system.

1305.2.6.2 Shutoff Dampers: Outdoor air supply ducts and exhaust ducts associated with the mechanical ventilation system shall be provided with automatic means to reduce and shutoff air flow.

Exception:

1. Systems serving areas designed for continuous operation .
2. Individual systems with an outside air intake or exhaust capacity of 300 cfm or less.
3. Systems with readily accessible manual dampers.

1305.2.7 Economizers: Each system over 65,000 Btu/h cooling capacity shall have an economizer that will automatically shut off the cooling system and allow 100% of the supply air to be outdoor air.

1305.2.8 Duct and Plenum Insulation and Sealing: All supply and return air ducts and plenums shall be insulated with a minimum of R-5 insulation when located in *unconditioned spaces* and with a minimum of R-8 insulation when located outside the building envelope. When located within a building envelope assembly the duct or plenum shall be separated from the building exterior or unconditioned or exempt spaces by a minimum R-5 insulation. Required R-values are the "labeled" R-values for such ducts.

Exception:

1. When located within equipment.

2. When the design temperature difference between the interior and exterior of the duct or plenum does not exceed 15°F.
3. Exhaust air ducts.
4. Outside air supply ducts located outside of the building envelope.

All joints, longitudinal and transverse seams, and connections in duct work, shall be securely fastened and sealed with welds, gaskets, mastics (adhesives), mastic-plus-embedded-fabric systems, or tapes. Tapes and mastics used with rigid fibrous glass ducts shall be listed and labeled in accordance with UL 181A. Tapes and mastics used with flexible air ducts shall be listed and labeled in accordance with UL 181B. Duct tape is not permitted as a sealant on any metal ducts.

1305.2.9 Piping Insulation: All low pressure side refrigerant piping shall be insulated with ¾ in. of insulation, hot water piping for comfort conditioning shall be insulated with one in. of insulation, and steam system piping shall be insulated with two in. of insulation. All insulation shall have a conductivity not exceeding 0.27 Btu-in./hr-ft^2 °F.

1305.3 Complex HVAC Systems and Equipment:

1305.3.1 Scope: This section applies to all HVAC systems and equipment other than those covered in 780 CMR 1305.2.

1305.3.2 Calculation of Heating and Cooling Loads: Design loads shall be determined in accordance with the procedures described in Chapters 25 and 26 of the ASHRAE 1997 Handbook of Fundamentals or an approved equivalent computation procedure.

1305.3.2.1 Equipment and System Sizing: Heating and cooling equipment and system capacity shall not exceed the loads calculated in accordance with 780 CMR 1305.3.2.

1305.3.3 HVAC Equipment Performance Requirements: Equipment shall be newly purchased or shall meet the minimum efficiency requirements of Tables 1305.3.3a. through f., when tested and rated in accordance with the referenced test procedure. The efficiency shall be verified through data furnished by the manufacturer or through an approved certification program. Where multiple rating conditions and/or performance requirements are provided, the equipment shall satisfy all stated requirements.

Other new equipment within the scope of 780 CMR 1305.3.3 is required to meet efficiency standards administered by the federal government. The efficiency of used equipment within the scope of the federal standards shall be verified through data furnished by the manufacturer.

Equipment not required to meet efficiency standards administered by the federal government, and not in Tables 1305.3.3a. through f. may be used, and have no minimum performance requirements.

1305.3.3.1 Duct Furnaces and Unit Heaters: Warm air duct furnaces and unit heaters shall have an intermittent ignition device, maximum jacket losses of 0.75% of the equipment input rating, and power venting or a flue damper. When combustion air is drawn from the conditioned space a vent damper shall be permitted to be used in lieu of the required flue damper.

Table 1305.3.3a
Unitary Air Conditioners and Condensing Units, Electrically Operated, Minimum Efficiency Requirements

Equipment Type	Size Category	Sub-Category or Rating Condition	Minimum Efficiency[a]	Test Procedure
Air Conditioners, Air Cooled	> 240,000 Btu/h and ≤ 760,000 Btu/h	Split System and Single Package	9.5 EER[b] 9.7 IPLV[b]	ARI 210/240
	> 760,000 Btu/h	Split System and Single Package	9.2 EER[b] 9.4 IPLV[b]	
Air Conditioners, Water and Evaporatively Cooled	> 240,000 Btu/h	Split System and Single Package	11.0 EER[b] 10.3 IPLV[b]	ARI 340/360
Condensing Units, Air Cooled	≥ 135,000 Btu/h		10.1 EER 11.2 IPLV	ARI 365
Condensing Units, Water or Evaporatively Cooled	≥ 135,000 Btu/h		13.1 EER 13.1 IPLV	

[a] IPLVs are only applicable to equipment with capacity modulation.

[b] Deduct 0.2 from the required EERs and IPLVs for units with a supplemental heating section other than electric resistance.

Table 1305.3.3b
Unitary and Applied Heat Pumps, Electrically Operated, Minimum Efficiency Requirements

Equipment Type	Size Category	Sub-Category or Rating Condition	Minimum Efficiency[a]	Test Procedure
Air Cooled, (Cooling Mode)	> 240,000 Btu/h	Split System and Single Package	9.0 EER[b] 9.2 IPLV[b]	ARI 340/360
Air Cooled, (Heating Mode)	> 240,000 Btu/h	47°F db/43°F wb outdoor 17°F db/10°F wb outdoor	3.1 COP 2.0 COP	ARI 340/360
Groundwater- Source (Cooling Mode)	< 135,000 Btu/h	70°F Entering Water 50°F Entering Water	13.5 EER 15.0 EER	ARI 325
Ground Source (Cooling Mode)	< 135,000 Btu/h	77°F Entering Brine 70°F Entering Brine	12.4 EER 12.8 EER	ARI 330
Groundwater- Source (Heating Mode)	< 135,000 Btu/h (Cooling Capacity)	70°F Entering Water 50°F Entering Water	3.9 COP 3.4 COP	ARI 325
Ground Source (Heating Mode)	< 135,000 Btu/h (Cooling Capacity)	32°F Entering Brine 41°F Entering Brine	2.8 COP 3.0 COP	ARI 330

[a] IPLVs are only applicable to equipment with capacity modulation.

[b] Deduct 0.2 from the required EERs and IPLVs for units with supplemental heating sections other than electric resistance heat.

Table 1305.3.3c
Water Chilling Packages, Minimum Efficiency Requirements

Equipment Type	Size Category	Minimum Efficiency[a]	Test Procedure
Air Cooled, With Condenser, Electrically Operated	All Capacities	2.80 COP 2.80 IPLV	ARI 550 or ARI 590 as appropriate
Air Cooled, Without Condenser, Electrically Operated	All Capacities	3.10 COP 3.10 IPLV	
Water Cooled, Electrically Operated, Positive Displacement (Reciprocating)	All Capacities	4.20 COP 4.65 IPLV	ARI 590
Water Cooled, Electrically Operated, Positive Displacement (Rotary Screw and Scroll)	< 150 Tons	4.45 COP 4.50 IPLV	ARI 550 or ARI 590 as appropriate
	≥ 150 Tons and < 300 Tons	4.90 COP 4.95 IPLV	
	≥ 300 Tons	5.50 COP 5.60 IPLV	
Water Cooled, Electrically Operated, Centrifugal	< 150 Tons	5.00 COP 5.00 IPLV	ARI 550
	≥ 150 Tons and < 300 Tons	5.55 COP 5.55 IPLV	
	≥ 300 Tons	6.10 COP 6.10 IPLV	
Air Cooled Absorption Single Effect	All Capacities	0.60 COP	ARI 560
Water Cooled Absorption Single Effect	All Capacities	0.70 COP	
Absorption Double Effect, Indirect-Fired	All Capacities	1.00 COP 1.05 IPLV	
Absorption Double Effect, Direct-Fired	All Capacities	1.00 COP 1.00 IPLV	

[a] The chiller equipment requirements do not apply for chillers used in low temperature applications where the design leaving fluid temperature is less than or equal to 35° F.

Table 1305.3.3d
Warm Air Duct Furnaces and Unit Heaters, Minimum Efficiency Requirements

Equipment Type	Size Category (Input)	Sub-Category or Rating Condition[a]	Minimum Efficiency[d]	Minimum Efficiency[c]	Test Procedure
Warm Air Duct Furnaces, Gas-Fired	All Capacities	Maximum Capacity Minimum Capacity	78% E_t 75% E_t	80% E_c ----	ANSI Z83.9
Warm Air Unit Heaters, Gas-Fired	All Capacities	Maximum Capacity Minimum Capacity	78% E_t 74% E_t	80% E_c ____	ANSI Z83.8
Warm Air Unit Heaters, Oil-Fired	All Capacities	Maximum Capacity Minimum Capacity	81% E_t 81% E_t	80% E_c ____	UL 731

[a] Minimum and maximum ratings as provided for and allowed by the unit's controls.

[c] E_c = Combustion efficiency (100% less flue losses). See test procedure for detailed discussion.

[d] E_t = Thermal efficiency. See test procedure for detailed discussion.

Table 1305.3.3e
Performance Requirements for Heat Rejection Equipment

Equipment Type	Total System Heat Rejection Capacity at Rated Conditions	Sub-Category or Rating Condition	Performance Required	Test Procedure[c]
Propeller or Axial Fan Cooling Towers	All	95 °F Entering Water 85°F Leaving Water 75°F wb Outdoor Air	≥ 38.2 gpm/hp[a]	CTI ATC-105
Centrifugal Fan Cooling Towers	All	95 °F Entering Water 85°F Leaving Water 75°F wb Outdoor Air	≥ 20.0 gpm/hp[a]	CTI ATC-105
Air Cooled Condensers	All	125 °F Condensing Temperature R22 Test Fluid 190°F Entering Gas T emperature 15°F Subcooling 95°F Entering Drybulb	≥ 176,000 Btu/h*hp[b]	ARI 460

[a] Maximum flow (gpm)/rated motor power (hp)

[b] Heat rejected from the refrigerant (Btu/h)/rated motor power (hp).

Table 1305.3.3f
Boilers, Gas- and Oil-Fired, Minimum Efficiency Requirements

Equipment Type	Size Category	Sub-Category or Rating Condition	Minimum Efficiency[b]	Efficiency as of 1/1/2001[c]	Test Procedure
Boilers, Gas-Fired	≥ 300,000 Btu/h and ≥ 2,500,000 Btu/h	Maximum Capacity[a] Minimum Capacity[a]	80% E_c 80% E_c	75% E_t	H.I. Htg Boiler Std 86[d]
	> 2,500,000 Btu/h	Hot Water	80% E_c	80% E_c	
	> 2,500,000 Btu/h	Steam	80% E_c	80% E_c	
Boilers, Oil-Fired	≥ 300,000 Btu/h and ≥ 2,500,000 Btu/h	Maximum Capacity[a] Minimum Capacity[a]	83% E_c 83% E_c	78% E_t ____	H.I. Htg Boiler Std 86[d]
	> 2,500,000 Btu/h	Hot Water	83% E_c	83% E_c	
	> 2,500,000 Btu/h	Steam	83% E_c	83% E_c	
Oil-Fired (Residual)	≥ 300,000 Btu/h and ≥ 2,500,000 Btu/h	Maximum Capacity[a] Minimum Capacity[a]	83% E_c 83% E_c	78% E_t ____	H.I. Htg Boiler Std 86[d]
	> 2,500,000 Btu/h	Hot Water	83% E_c	83% E_c	
	> 2,500,000 Btu/h	Steam	83% E_c	83% E_c	

[a] Minimum and maximum ratings as provided for and allowed by the unit's controls.

[b] E_c = Combustion efficiency (100% less flue losses). See reference document for detailed information.

[c] E_t = Thermal efficiency. See reference document for detailed information.

[d] Alternate test procedures used at the manufacturer's option are ASME PTC-4.1 for units over 5,000,000 Btu/h input, or ANSI Z21.13 for units greater than or equal to 300,000 Btu/h and less than or equal to 2,500,000 Btu/h input.

1305.3.4 Temperature and Humidity Controls

1305.3.4.1 Thermostatic Controls: The supply of heating and cooling energy to each zone shall be individually controlled by thermostatic controls capable of responding to temperature within the zone.

Exception: Independent perimeter systems that are designed to offset only building envelope heat losses and/or gains serving one or more zones also served by an interior system provided:

1. the perimeter system includes at least one thermostatic control zone for each building exposure of the building (face within ± 45°) having exterior walls facing only one orientation for more than 50 contiguous feet and,
2. the perimeter system heating and cooling supply is controlled by thermostatic controls located within the zone(s) served by the system.

1305.3.4.2 Zone Thermostatic Control Capabilities:

1305.3.4.2.1 Set point Overlap Restriction: Where used to control both heating and cooling, zone thermostatic controls shall be capable of providing a temperature range or dead band of at least 5°F within which the supply of heating and cooling energy to the zone is shut off or reduced to a minimum.

Exception: Thermostats requiring manual changeover between heating and cooling modes.

Where heating and cooling to a zone are controlled by separate zone thermostatic controls located within the zone, means (such as limit switches, mechanical stops, or, for *direct digital control* (DDC) systems, software programming) shall be provided to prevent the heating set point from exceeding the cooling set point minus any applicable proportional band.

1305.3.4.2.2 Off-hour Controls: HVAC systems shall have setback and automatic controls.

Exception:

1. Systems that serve areas that operate continuously, or
2. Systems with full load demands not exceeding 2 kW when having a readily accessible manual shut off switch.

Thermostatic setback controls shall have the capability to setback or temporarily operate the system to maintain zone temperatures down to 55 °F or up to 85 °F.

HVAC systems shall be equipped with an automatic timeclock or programmable control that is capable of starting and stopping the system for seven different daily schedules per week, retaining programming and time setting during loss of power for a period of at least ten hours, and has a manual override that allows temporary operation of the system for up to two hours; a manually-operated timer capable of being adjusted to operate the system for up to two hours; or an occupancy sensor.

1305.3.4.3 Zone Isolation: Systems that serve zones that will have the capability to operate non- simultaneously shall include isolation devices and controls to shut off or set back the supply of ventilation air, heating, and cooling to each zone independently. For offices, each isolation area shall be no larger than 25,000 ft^2 of conditioned floor area nor include more than one floor. For all other occupancies, isolation areas shall be no larger than a single *zone*, a single tenant space, or 5000 ft^2 of conditioned floor area, whichever is larger.

Exception: exhaust air and outside air connections to fan systems of 5,000 cfm and smaller.

1305.3.4.4 Humidifier Preheat: Humidifiers with preheating jackets mounted in the air stream shall be provided with an automatic valve to shut off preheat when humidification is not required.

1305.3.4.5 Humidification and Dehumidification: Where a *zone* is served by a system or systems with both humidification and dehumidification capability, means (such as limit switches, mechanical stops, or, for *direct digital control* (DDC) systems, software programming) shall be capable of preventing simultaneous operation of humidification and dehumidification equipment.

Exception:

1. Zones served by desiccant systems, used with direct evaporative cooling in series.
2. Systems serving zones where specific humidity levels are required, such as computer rooms, museums, and hospitals.

1305.3.4.6 Simultaneous Heating and Cooling: Zone thermostatic and humidistatic controls shall be capable of operating in sequence the supply of heating and cooling energy to the zone. Controls shall be capable of preventing reheating; recooling; mixing, or simultaneously supplying air that has been previously mechanically heated and air that has been previously cooled either by economizer operation or mechanical cooling.

Exception:

1. Variable air volume systems which, during periods of occupancy, are designed to reduce the primary air supply to each zone to a minimum before reheating, recooling, or mixing takes place.
2. Zones where special pressurization relationships or cross-contamination requirements are such that variable air volume systems are impractical.
3. At least 75% of the energy for reheating or for providing warm air in mixing systems is provided from a site-recovered or site-solar energy source.
4. Zones where special humidity levels are required to satisfy process needs.
5. Zones with a peak supply air quantity of 300 cfm or less and where the flow rate is less than 10% of the total fan system flow rate.
6. Zones where the volume of air to be reheated, recooled, or mixed is no greater than the volume of outside air required to meet the minimum ventilation requirements of 780 CMR 1305.3.6.

1305.3.4.7 Temperature Reset for Air Systems: Air systems supplying heated or cooled air to multiple zones shall include controls that have the capability to automatically reset the supply air in response to measured parameters representative of building loads or by outside air temperature. Temperature shall be capable of being reset by at least 25% of the design supply air to room air temperature difference.

Exception: Systems that comply with 780 CMR 1305.3.4.6 without using Exceptions 1, 2 or 6.

1305.3.5 Hydronic System Controls: The heating of fluids that have been previously mechanically cooled and the cooling of fluids that have been previously mechanically heated shall be limited in accordance with 780 CMR 1305.3.5.1 through 1305.3.5.3.

Hydronic heating systems comprised of multiple packaged boilers and designed to deliver conditioned water or steam into a common distribution system shall include automatic controls capable of sequencing operation of the boilers.

Hydronic heating systems comprised of a single boiler and greater than 500,000 Btu/h design capacity shall include either a multi-staged or modulating burner.

1305.3.5.1 Three-pipe System: Hydronic systems that use a common return system for both hot water and chilled water are prohibited.

1305.3.5.2 Two-pipe Changeover System: Systems that use a common distribution system to supply both heated and chilled water shall: be designed to allow a dead band between changeover from one mode to the other of at least 15°F outside air temperature; be designed to and provided with controls that will allow operation in one mode for at least 4 hours before changing over to the other mode; and be provided with controls that allow heating and cooling supply temperatures at the changeover point to be no more than 30°F apart.

1305.3.5.3 Hydronic (Water Loop) Heat Pump Systems: Hydronic heat pumps connected to a common heat pump water loop with central devices for heat rejection and heat addition shall have controls that are capable of providing a heat pump water supply temperature dead band of at least 20°F between initiation of heat rejection and heat addition by the central devices. If a closed-circuit cooling tower is used, either an automatic valve shall be installed to bypass all but a minimal flow of water around the tower, or low leakage positive closure dampers shall be provided. If an open-circuit cooling tower is used directly in the heat pump loop, an automatic valve shall be installed to bypass all heat pump water flow around the tower. If an open-circuit cooling tower is used in conjunction with a separate heat exchanger to isolate the cooling tower from the heat pump loop, then heat loss shall be controlled by shutting down the circulation pump on the cooling tower loop. Each hydronic heat pump on the hydronic system having a total pump system power exceeding ten hp shall have a two-position valve.

Exception: Where a system loop temperature optimization controller is installed and can determine the most efficient operating temperature based on real time conditions of demand and capacity, dead bands of less than 20°F shall be permitted.

1305.3.5.4 Hydronic Variable Flow Systems: HVAC pumping systems that include control valves designed to modulate or step open and closed as a function of load shall be designed for variable fluid flow and be capable of reducing pump flow rates to 50% or less of the design flow rate.

1305.3.5.5Maximum Power Use: Individual pumps serving variable flow systems having pump motors greater than 50 hp shall include controls that are capable of limiting pump motor demand to no more than 30% of design power input at 50% of design water flow.

1305.3.6 Ventilation: Ventilation, either natural or mechanical, shall be provided in accordance with the mechanical code listed in *Appendix A*. Where mechanical ventilation is provided the system shall provide the capability to reduce the outdoor air supply to the minimum required by the mechanical code listed in *Appendix A*.

1305.3.6.1 System Controls: Mechanical ventilation systems shall be provided with manual or automatic controls that will allow the fan system to operate whenever the spaces served are occupied. Air conditioning systems that supply required ventilation air shall be provided with controls designed to automatically maintain the required outdoor air supply rate during occupancy.

1305.3.6.2 Ventilation Controls for High-Occupancy Areas: Systems with design outside air capacities greater than 3000 cfm serving areas having an average design occupancy density exceeding 100 people per 1000 ft^2 shall include means to automatically reduce outside air intake below design rates when spaces are partially occupied. Ventilation controls shall be in compliance with *ASHRAE Standard 62* and local standards.

Exception: fan systems with energy recovery.

1305.3.6.3 Distributed Fan Systems: Where mechanical ventilation is provided by multiple fan systems located in a plenum or other enclosed space, outdoor air shall be ducted directly to each individual fan system.

1305.3.6.4 Outdoor Air Intake Control: Variable air volume systems shall have controls that are capable of maintaining total system outdoor airflow at not less than 90% of the outdoor air supply rates required by 780 CMR 1305.3.6.

1305.3.6.5 Zone Minimum Air Flow: Variable air volume zone controls shall maintain the hourly average outdoor supply air rate at not less than the minimum supply rate required by 780 CMR 1305.3.6 under any thermal load condition expected to occur when the spaces served are occupied.

1305.3.6.6 Shutoff Damper Controls: Both outdoor air supply and exhaust ducts associated with the mechanical ventilation system shall be equipped with motorized dampers that will automatically shut when the systems or spaces served are not in use.

Exception:

1. Gravity (non-motorized) dampers installed in buildings less than three stories in height above grade.
2. Individual supply systems with an outside air intake or exhaust capacity of 300 cfm or less.

1305.3.7 Economizers: Each cooling system including the fan with a total cooling capacity of at least 65,000 Btu/h shall have an air or water economizer.

Cooling fan systems with a total cooling capacity less than 65,000 Btu/hr shall have an air or water economizer in buildings three stories and taller where the total cooling capacity of all such systems exceeds 2,400,000 Btu/h or 10% of the total installed cooling capacity, whichever is larger.

Exception:

1. Systems that include gas phase air cleaning in order to meet ventilation requirements.
2. Where more than 25% of the air designed to be supplied by the system is to spaces that are designed to be humidified above 35°F (2°C) dewpoint temperature in order to satisfy process needs.
3. Systems that include a condenser heat recovery system complying with 780 CMR 1305.3.12.
4. Systems that serve residential spaces where the system capacity is less than 325,000 cfm.
5. Systems that serve spaces whose sensible cooling load at design conditions, excluding transmission and infiltration loads, is less than or equal to transmission and infiltration losses at an outdoor temperature of 60°F.
6. Systems expected to operate less than 20 hours per week.
7. Where the use of outdoor air for cooling will affect supermarket open refrigerated casework systems.

1305.3.7.1 Air Economizers: Air economizers shall be designed to modulate outside air and return air dampers to provide up to the design supply air quantity as outside air.

Economizer dampers shall be capable of being sequenced with the mechanical cooling equipment and shall be controlled by other than mixed air temperature alone. The use of mixed air temperature limit control shall be permitted for systems controlled from space temperature (such as single-*zone* systems).

Air economizers shall be designed to automatically reduce the minimum supply of outside air to the minimum quantities required by 780 CMR 1305.3.6 when the use of outside air will no longer reduce cooling energy usage. Means shall be provided to relieve or exhaust excess return air during air economizer operation. The relief air outlet shall be located to avoid reintroduction of exhaust air into the building.

Controls shall be permitted to be installed to reduce the quantity of outdoor air to prevent coil frosting at the lowest stage of compressor unloading.

1305.3.8 Duct and Plenum Insulation and Sealing: All supply and return air ducts and plenums shall be insulated with a minimum of R-5 insulation when located in *unconditioned spaces* and with a minimum of R-8 insulation when located outside the building envelope. When located within a building envelope assembly the duct or plenum shall be separated from the building exterior or unconditioned or exempt spaces by a minimum R-5 insulation. Required R-values are the "labeled" R-values for such ducts.

Exception:

1. When located within equipment.
2. When the design temperature difference between the interior and exterior of the duct or plenum does not exceed 15°F.
3. Exhaust air ducts.
4. Outside air supply ducts located outside of the building envelope.

All joints, longitudinal and transverse seams, and connections in duct work, shall be securely fastened and sealed with welds, gaskets, mastics (adhesives), mastic-plus-embedded-fabric systems, or tapes. Tapes and mastics used with rigid fibrous glass ducts shall be listed and labeled in accordance with UL 181A. Tapes and mastics used with flexible air ducts shall be listed and labeled in accordance with UL 181B. Duct tape is not permitted as a sealant on any metal ducts.

Ducts designed to operate at static pressures in excess of three in. w.c. shall be leak-tested in accordance with the SMACNA HVAC air duct leakage test manual with the rate of air leakage less than or equal to 6.0 as determined in accordance with Equation 1305.3.8.

$$L_{max} = C_L P^{0.65}$$

Where:

L_{max} = the maximum permitted leakage in cfm per 100 ft^2 duct surface

C_L = 6 for square/rectangular sheetmetal or fibrous ducts, three for round/oval sheetmetal, fibrous or flexible ducts

P = test pressure which shall be equal to the design duct pressure class rating in inches w.c.

1305.3.9 Piping Insulation: All piping serving as part of a heating or cooling system shall be thermally insulated in accordance with Table 1305.3.9.

Exception:

1. Factory-installed piping within HVAC equipment tested and rated in accordance with 780 CMR 1305.3.3.
2. Piping that conveys fluids that have a design operating temperature range between 55°F and 105°F
3. Piping that conveys fluids that have not been heated or cooled through the use of fossil fuels or electrical power.
4. Hot water runout piping not exceeding 4 ft. in length and 1 in. diameter or less between the control valve and HVAC coil.

Table 1305.3.9
Minimum Pipe Insulation Thickness[a]

Fluid Design Operating Temp. Range (°F)	Insulation Conductivity		Nominal Pipe or Tube Size (in.)				
	Conductivity Btu*in./(h*ft2*°F)	Mean Rating Temp. (°F)	< 1	1 to <1½	1½ to < 4	4 to < 8	≥ 8
Heating Systems (Steam, Steam Condensate and Hot Water)							
>350	0.32-0.34	250	2.5	3.0	3.0	4.0	4.0
251-350	0.29-0.32	200	1.5	2.5	3.0	3.0	3.0
201-250	0.27-0.30	150	1.5	1.5	2.0	2.0	2.0
141-200	0.25-0.29	125	1.0	1.0	1.0	1.5	1.5
105-140	0.22-0.28	100	0.5	0.5	1.0	1.0	1.0
Domestic and Service Hot Water Systems							
105 and Greater	0.22-0.28	100	0.5	0.5	1.0	1.0	1.0
Cooling Systems (Chilled Water, Brine, and Refrigerant)							
40-60	0.22-0.28	100	0.5	0.5	1.0	1.0	1.0
Below 40	0.22-0.28	100	0.5	1.0	1.0	1.0	1.5

[a] For insulation outside the stated conductivity range, the minimum thickness (T) shall be determined as follows:

$$T = r\{(1 + t/r)^{K}/k$$

Where:

T = minimum insulation thickness (in.),

r = actual outside radius of pipe (in.),

t = insulation thickness listed in this table for applicable fluid temperature and pipe size,

K = conductivity of alternate material at mean rating temperature indicated for the applicable fluid temperature [Btu*in.(h*ft²*°F)]; and

k = the upper value of the conductivity range listed in this table for the applicable fluid temperature.

1305.3.10 Fan System Power: The ratio of the nameplate *fan system power* to the supply fan air flow rate of each HVAC system at design conditions shall not exceed the requirements shown in Table 1305.3.10. *Fan system power* shall be adjusted in accordance with Equation 1305.3.10 for the additional power required by process loads, air treatment or filtering systems with design pressure drops over one in. w.c. when filters are clean, heat recovery coils or devices, or direct evaporative humidifiers/coolers.

Equation 1305.3.10

Adjusted fan system power = Fan system power - HP Credit

HP Credit (hp) = Sum of [CFM_n x (SP_n - 1.0)/3718] + Sum of [CFM x SP_{HR}/3718]

Where:

CFM_n =Supply air volume of the unit with the filtering system, cfm

SP_n = Air pressure drop of the filtering system when filters are clean, in. w.c.

SP_{HR} = Air pressure drop of heat recovery coils or direct evaporative humidifier/cooler, in. w.c.

Table 1305.3.10
Fan Power Limitation

Supply Air Volume	Allowable Nameplate Motor Power	
	Constant Air Volume	Variable Air Volume
< 20,000 cfm	1.2 hp/1,000 cfm	1.7 hp/1,000 cfm
> 20,000 cfm	1.1 hp/1,000 cfm	1.5 hp/1,000 cfm

1305.3.10.1 Variable Air Volume (VAV) Fan Control: Individual VAV fans with motors 25 hp and larger shall have controls or devices that will result in fan motor demand of no more than 30% of design wattage at 50% of design air volume when static pressure set point equals ⅓ of the total design static pressure, based on manufacturer's certified fan data.

Static pressure sensors used to control variable air volume fans shall be placed in a position such that the controller set point is not able to exceed ⅓ the total design fan static pressure. If this results in the sensor being located downstream of splits in primary duct runs, multiple sensors shall be installed in each major duct.

For systems with direct digital control at the zone level, static pressure set points shall be capable of being reset based on the zone requiring the most pressure.

1305.3.10.2 Fan-Powered VAV Boxes: Fan-Powered VAV boxes shall be capable of being controlled to shut off when the primary system is off except as required to maintain the *zone* at setback temperatures.

1305.3.11 Heat Rejection Equipment:

1305.3.11.1 General: 780 CMR 1305.3.11 applies to heat rejection equipment used in comfort cooling systems covered in Table 1305.3.3e.

1305.3.11.2 Fan Speed Control: Each fan associated with a heat rejection device covered in Table 1305.3.3e and powered by a motor of 7.5 hp or larger shall have a fan speed control with the capability to operate that fan at two-thirds of full speed or less, and shall have controls that are capable of automatically changing the fan speed to control the leaving fluid temperature or condensing temperature/pressure of the heat rejection device.

Exception:

1. Condenser fans serving multiple refrigerant circuits.
2. Condenser fans serving flooded condensers.
3. Up to ⅓ of the fans on a condenser or tower with multiple fans where the lead fans comply with the speed control requirement

1305.3.12 Exhaust Air Energy Recovery: HVAC fan systems that have both a design supply air capacity of 5000 cfm or greater and have a minimum outside air supply of 70% or greater of the design supply air quantity shall have an energy recovery system that is capable of providing a change in the enthalpy or dry-bulb temperature of the outdoor air supply equal to at least 50% of the difference between the outdoor air and return air at design conditions. A heat recovery system bypass shall be provided to permit air economizer operation as required by 780 CMR 1305.3.7.

Exception:

1. Laboratory systems meeting 780 CMR1305.3.13.2.
2. Systems serving spaces which are not cooled and which are heated to less than 60°F.
3. Systems exhausting toxic, flammable, paint exhaust, corrosive fumes, or dust which makes the installation of heat recovery equipment impractical.
4. Commercial kitchen hoods (grease) classified as Type 1 by *NFPA 96*.
5. Where more than 60% of the outdoor heating energy is provided from site-recovered or site solar energy

1305.3.13 Exhaust Hoods:

1305.3.13.1 Kitchen Hoods: Individual kitchen exhaust hoods larger than 5000 cfm shall be provided with make-up air sized for at least 50% of exhaust air volume that is

(a) heated to no more than 60°F and

(b) uncooled or cooled without the use of mechanical cooling.

Exception:

1. Where hoods are used to exhaust ventilation air which would otherwise exfiltrate or be exhausted by other fan systems.
2. Certified grease extractor hoods that require a face velocity no greater than 60 fpm.

1305.3.13.2 Fume Hoods: Buildings with fume hood systems having a total exhaust rate greater than 15,000 cfm shall include at least one of the following features:

1. Variable air volume hood exhaust and room supply systems capable of reducing exhaust and make-up air volume to 50% or less of design values.
2. Direct make-up (auxiliary) air supply equal to at least 75% of the exhaust rate, heated no warmer than 2°F below room set point, cooled to no cooler than 3°F above room set point, no humidification added, and no simultaneous heating and cooling used for dehumidification control.
3. Heat recovery systems to precondition make-up air from fume hood exhaust in accordance with 780 CMR 1305.3.12 Exhaust Air Heat Recovery, without using any exception.

780 CMR 1306.0 SERVICE WATER HEATING

1306.1 General: 780 CMR 1306.0 covers installation of service hot water piping and controls for service water heating equipment.

1306.2 Temperature Controls: Service water heating equipment shall be provided with controls to allow a set point of 110°F for equipment serving dwelling units and 90°F for equipment serving other occupancies. The outlet temperature of lavatories in public facility restrooms shall be limited to 110°F.

1306.3 Heat Traps: Water heating equipment not supplied with integral heat traps and serving non - circulating systems shall be provided with heat traps on the supply and discharge piping associated with the equipment.

1306.4 Service Hot Water Piping Insulation: Piping on return circulation hot water systems, shall be insulated with 1 inch of insulation having a conductivity not exceeding 0.28 Btu per inch/h*ft^2*°F. The first eight feet of piping in *nonrecirculating* systems served by equipment without integral heat traps shall be insulated with 1 inch of insulation having a conductivity not exceeding 0.28 Btu per inch/h*ft^2 *°F.

1306.5 Hot Water System Controls: Circulating hot water systems or heat trace shall have automatic time switches that are capable of being set to turn off the system.

1306.6 Swimming pools:

1306.6.1 Pool Covers: Heated pools shall be equipped with a vapor retardant pool cover on or at the water surface.

Exception: Pools deriving over 60% of the energy for heating from site-recovered energy or solar energy source.

1306.6.2 Pool Heaters: Pool heaters shall meet the efficiency requirements for boilers. Pool heaters fired by natural gas shall not have continuously burning pilot lights.

1306.6.3 On-off Switch: Pool heaters shall be equipped with a readily accessible on-off switch to allow shutting off the heater without adjusting the thermostat setting.

1306.6.4 Time Switches: Time switches shall be installed on swimming pool heaters and pumps.

Exceptions:

1. Where public health standards require 24-hour pump operation.
2. Where pumps are required to operate solar and waste heat recovery pool heating systems.

1306.6.5 Temperature Controls: Heated swimming pools shall be equipped with controls to limit heating water temperatures to not more than 80°F.

Exception: Pools used for therapeutic purposes are exempt when approved by the building official.

1306.7 Space Heating and Water Heating: The use of a gas-fired or oil-fired space heating boiler system to provide the total space heating and water heating for a building is allowed when one of the following conditions is met:

1. The single space heating boiler, or the component of a modular or multiple boiler system that is heating the service water, has a standby loss in Btu/h not exceeding

$$(13.3 \text{ x pmd} + 400) / n$$

where pmd is the probable maximum demand in gal/h determined in accordance with the procedures described in generally accepted engineering standards and handbooks and n is the fraction of the year when the outdoor daily mean temperature is greater than 64.9°F.

The standby loss is to be determined for a test period of 24-hour duration while maintaining a boiler water temperature of at least 90°F above ambient, with an ambient temperature between 60°F and 90°F. For a boiler with a modulating burner, this test shall be conducted at the lowest input.

2. It can be demonstrated that the use of a single heat source will provide energy savings compared to separate units.
3. The energy input of the combined boiler and water heater system is less than 150,000 Btu/h.

780 CMR 1307.0 ELECTRIC POWER DISTRIBUTION

1307.1 Scope: Electrical distribution systems shall be designed for the efficient distribution of electrical energy from the service entrance to the points of use.

Exceptions:
1. Buildings in use groups R-3 and R-4 (one-and two-family dwellings).
2. *Emergency power systems.*

1307.2 Electrical Metering: In all multi-family dwellings, each dwelling unit shall be separately metered. Also see 527 CMR 12.00.

Exceptions:
1. Publicly financed housing for the elderly with fuel fired heating systems, with centrally operated air conditioning systems, or without air conditioning systems are exempt from this requirement.
2. Publicly financed housing for the elderly with electric resistance or storage heating systems are exempt from this requirement provided there is informational metering of the individual dwelling units.

1307.3 Voltage Drop:

1307.3.1 Feeders: *Feeder conductors* shall be designed for a maximum *voltage drop* of 2% at the design load calculated in accordance with 780 CMR 2701.0.

1307.3.2 Branch Circuits: *Branch circuit* conductors shall be designed for a maximum *voltage drop* of 3% at the design load calculated in accordance with 780 CMR 2701.0.

1307.4 Transformers: Single-phase and three-phase dry-type and liquid-filled distribution transformers first installed after December 31, 1999 shall be selected based on rating as described in 780 CMR 1307.4.1 and 1307.4.2.

Exceptions:
1. liquid-filled transformers below ten kVA or dry-type transformers below 15 kVA
2. drive transformers, both AC and DC
3. all rectifier transformers and transformers designed for high harmonics
4. autotransformers
5. non-distribution transformers, such as UPS (Uninterruptible Power Supply) transformers
6. special impedance, regulation, and harmonic transformers
7. sealed and non-ventilated transformers
8. retrofit transformers, machine tool transformers, or welding transformers
9. transformers with tap ranges greater than 15% or frequency other than 60 Hz
10. grounding or testing transformers.

1307.4.1 Liquid-Immersed Transformers: Liquid-immersed *transformers* shall comply with the minimum efficiencies in Table 1307.4.1 as tested and rated in accordance with Section 313 of the Electric Utility Industry Restructuring Act of November 25, 1997 ("NEMA TP1.")

Table 1307.4.1
NEMA Class 1 Efficiency Levels for Liquid-Filled Distribution Transformers

Reference Condition	Temperature	% of Nameplate Load
Load Loss	85°C	50%
No Load Loss	20°C	50%

kVA	Single Phase Efficiency	kVA	Three Phase Efficiency
10	98.3	15	98.0
15	98.5	30	98.3
25	98.7	45	98.5
37.5	98.8	75	98.7
50	98.9	112.5	98.8
75	99.0	150	98.9
100	99.0	225	99.0
167	99.1	300	99.0
250	99.2	500	99.1
333	99.2	750	99.2
500	99.3	1000	99.2
667	99.4	1500	99.3
883	99.4	2000	99.4
		2500	99.4

1307.4.2 Dry-Type Transformers:. Dry-type *transformers* shall comply with the minimum efficiencies in Table 1307.4.2 as tested and rated in accordance with NEMA TP 1:

Table 1307.4.2
NEMA Class 1 Efficiency Levels for Dry-Type Distribution Transformers

Reference Condition	Temperature	% of Nameplate Load
Low Voltage	75°C	35%
Medium Voltage	75°C	50%

Single Phase Efficiency			Three Phase Efficiency		
kVa	Low Voltage	Medium Voltage	kVa	Low Voltage	Medium Voltage
15	97.7	97.6	15	97.0	96.8
25	98.0	97.7	30	97.5	97.3
37.5	98.2	98.1	45	97.7	97.6
50	98.3	98.2	75	98.0	97.9
75	98.5	98.4	112.5	98.2	98.1
100	98.6	98.5	150	98.3	98.2
167	98.7	98.7	225	98.5	98.4
250	98.8	98.8	300	98.6	98.5
333	98.9	98.9	500	98.7	98.7
500	--	99.0	750	98.8	98.8
667	--	99.0	1000	98.9	98.9
833	--	99.1	1500	--	99.0
			2000	--	99.0
			2500	--	99.1

780 CMR 1308.0 LIGHTING SYSTEMS

1308.1 General: The lighting criteria in 780 CMR 1308.0 shall apply to lighting for the following:

1. interior spaces of *buildings*;
2. exterior building features, including facades, illuminated roofs, architectural features, entrances, exits, loading docks, and illuminated canopies; and,
3. exterior building grounds lighting provided through the *building's* electrical *service*.

Exceptions:

1. emergency lighting that is automatically off during normal *building* operation and is powered by battery, generator, or other alternate power source; and,
2. lighting within living units of residential buildings;
3. lighting that is specifically designated as required by a health or life safety statute, ordinance, or regulation;
4. decorative gas lighting systems.

1308.2 Lighting Control:

1308.2.1 Automatic Lighting Shutoff: Interior lighting in *buildings* larger than 5000 ft^2 shall be controlled with an *automatic control device* to shut off *building* lighting in all spaces. This *automatic control device* shall function on either:

1. a scheduled basis using a time of day operated control device that turns lighting off at specific programmed times. An independent program schedule shall be provided for areas of no more than 25,000 ft^2 but not more than one floor; or
2. an occupant sensor that shall turn lighting off within 30 minutes of an occupant leaving a space; or
3. an unscheduled basis by occupant intervention.

Exception 1: Lighting intended for 24 hour operation shall not require an Automatic Control Device.

Exception 2: Automatic Control Devices are not required in the following spaces: corridors, hallways, stairways and lobbies which are part of a required means of egress; restrooms; mechanical rooms, and; electrical rooms. If automatic control devices are used in the spaces listed, they shall not reduce illumination below the levels prescribed in 780 CMR 1024.0 (Means of Egress Lighting.)

1308.2.2 Space Control: Each space enclosed by ceiling-height partitions shall have at least one *control device* to independently *control* the *general lighting* within the space. Each *control device* shall be activated either manually by an occupant or automatically by sensing an occupant. Each *control device* shall:

1. *control* a maximum of 2,500 ft^2 area for a space 10,000 ft^2 or less, and a maximum of 10,000 ft^2 area for a space greater than 10,000 ft^2,
2. be capable of overriding the shutoff *control* required in 1308.2.1 for no more than two hours, and
3. be readily accessible and located so the occupant can see the controlled lighting.

Exception 1: Remote location shall be permitted for reasons of safety or security when the remote control device has an indicator pilot light as part of or next to the control device and it shall be clearly labeled to identify the controlled lighting.

Exception 2: Means of egress lighting which provides the minimum illumination identified in 780 CMR 1308.2.1 Exception 2 shall be controlled in accordance with 780 CMR 1024.

1308.2.3 Uniform Reduction: Each perimeter office space enclosed by ceiling-height partitions shall have a manual control to allow the occupant to uniformly reduce the connected lighting load by at least 50%

Exception: Spaces with automatic daylighting controls.

1308.2.4 Additional Control:

1. Display/Accent Lighting - display or accent lighting shall have a separate *control device.*
2. Case Lighting - lighting in cases used for display purposes shall be equipped with a separate *control device.*
3. Hotel and Motel Guest Room Lighting - hotel and motel guest rooms and guest suites shall have a master *control device* at the main room entry that *controls* all *permanently installed luminaires* and switched receptacles.
4. Task Lighting - supplemental task lighting including *permanently installed* undershelf or undercabinet lighting shall have a *control device* integral to the *luminaires* or shall be controlled by a wall- mounted *control device* provided the *control device* complies with 780 CMR 1308.2.2.
5. Nonvisual Lighting - lighting for nonvisual applications, such as plant growth and food-warming, shall be equipped with a separate control *device.*
6. Demonstration Lighting - *lighting equipment* that is for sale or for demonstrations in lighting education shall be equipped with a separate *control device.*

1308.2.5 Exterior Lighting Control: Lighting for all exterior applications not exempted in 780 CMR 1308.1 or 1308.7 shall be controlled by a photosensor or astronomical time switch that is capable of automatically turning off the exterior lighting when sufficient daylight is available or the lighting is not required.

Exception: Lighting for covered vehicle entrances or exits from buildings or parking structures where required for safety, security or eye adaptation.

1308.3 Tandem Wiring: Luminaires designed for use with one or three linear fluorescent lamps greater than 30 W each shall use two lamp tandem-wired ballasts in place of single lamp ballasts when two or more luminaires are in the same space and on the same control device.

Exceptions:

1. recessed luminaires more than ten ft apart measured center to center,
2. surface mounted or pendant luminaires which are not continuous,
3. luminaires using single lamp high-frequency electronic ballasts,
4. luminaires using three lamp high-frequency electronic ballasts or three lamp electromagnetic ballasts,
5. luminaires on emergency circuits,
6. luminaires with no available pair.

1308.4 Exit Signs: Exit sign *luminaires* operating at greater than 20 watts shall have a minimum source efficacy of 35 lm/W.

1308.5 Exterior Building Grounds Lighting: All exterior building grounds luminaires which operate at greater than 100 watts shall contain lamps having a minimum efficacy of 60 lm/W unless the luminaire is controlled by a motion sensor or qualifies for one of the exceptions under 780 CMR 1308.1 or 1308.7.

1308.6 Interior Lighting Power: The *installed interior lighting power* identified in accordance with 780 CMR 1308.6.1 shall not exceed the *interior lighting power allowance* developed in accordance with 780 CMR 1308.6.2.

1308.6.1 Installed Interior Lighting Power: The *installed interior lighting power* shall include the power of all *lighting*. The *installed interior lighting power* includes all power used by the *luminaires*, including *lamps*, *ballasts*, current regulators, and *control devices*.

Exceptions:

1. If two or more independently operating lighting systems in a space are capable of being controlled to prevent simultaneous user operation, the installed interior lighting power shall be based solely on the lighting system with the highest wattage.
2. The following *lighting equipment* and applications shall not be considered when determining the *interior lighting power allowance* developed in accordance with 780 CMR 1308.6.2, nor shall the wattage for such lighting be included in the *installed interior lighting power*. However, any such lighting shall not be exempt unless it is an addition to general lighting and is controlled by an independent *control device*.
   a. Lighting in spaces specifically designed for use by the visually impaired.

b. Lighting in *retail* display windows, provided the display area is enclosed by ceiling-height partitions.

c. Lighting in interior spaces that have been specifically designated as a registered interior *historic* landmark.

d. Athletic playing areas with permanently installed lighting for television broadcasting.

e. Casino gambling areas.

3. The following *lighting equipment* shall not be included in the *installed interior lighting power*. However, any such lighting shall not be exempt unless it is an addition to general lighting and is controlled by an independent *control device*.

a. Display or accent lighting that is an essential element for the function performed in galleries, museums, and monuments.

b. Lighting that is integral to *equipment* or instrumentation and is installed by its *manufacturer*.

c. Lighting specifically designed for use only during medical or dental procedures and lighting integral to medical *equipment*.

d. Lighting integral to both open and glass enclosed refrigerator and freezer cases.

e. Lighting integral to food warming and food preparation *equipment*.

f. Lighting for plant growth or maintenance.

g. Lighting that is an integral part of advertising or directional signage.

h. Exit signs.

i. Lighting that is for sale or lighting educational demonstration *systems*.

j. Lighting for theatrical purposes, including, performance, stage, and film and video production.

1308.6.1.1 Luminaire Wattage: Luminaire wattage incorporated into the installed interior lighting power shall be determined in accordance with the following criteria:

1. the wattage of incandescent or tungsten-halogen luminaires with medium screw base sockets and not containing permanently installed ballasts shall be the maximum labeled wattage of the luminaire.

Exceptions:

1. Luminaires for which lower wattage lamps are specified in construction documents, maintenance and operating manuals, and reports specified in 780 CMR 1301.8.4.

2. the wattage of luminaires with permanently installed or remotely installed ballasts shall be the operating input wattage of the specified lamp/ballast combination based on values from manufacturers catalogs or values from independent testing lab reports.

3. the wattage of line voltage lighting track and plug-in busway that allow the addition and/or relocation of luminaires without altering the wiring of the system shall be the lower of:

a. the specified wattage of the luminaires included in the system with a minimum of 30 W/lin ft.

b. the specified wattage of the circuit protection device.

4. the wattage of low-voltage lighting track, cable conductor, rail conductor, and other flexible lighting systems that allow for the addition and/or relocation of luminaires without altering the wiring of the system shall be the specified wattage of the transformer supplying the system.

5. the wattage of all other miscellaneous lighting equipment shall be the specified wattage of the equipment.

1308.6.2 Interior Lighting Power Allowance: The *interior lighting power allowance* for a *building* or a separately metered or permitted portion of a *building* shall be determined by either the *building* area method described in 780 CMR 1308.6.2.1 or the Space-by-Space method described in 780 CMR 1308.6.2.2. Trade-offs of *interior lighting power allowance* among portions of the *building* for which a different method of calculation has been used are not permitted.

1308.6.2.1 Building Area Method of Calculating Interior Lighting Power Allowance: The Building Area Method shall be used only in the following cases: a) projects involving the entire building, or b) projects involving a single, independent, and separate occupancy in a multi-occupancy building. Use the following steps to determine the interior lighting power allowance by the Building Area Method:

1. Determine the appropriate building type from Table 1308.6.2.1 and the allowed lighting power density (watts/unit area) from the building area method column. For building types not listed, selection of a reasonably equivalent type shall be permitted.

2. Determine the gross lighted floor area (square feet) of the *building*.

3. The *interior lighting power allowance* is the product of the lighted floor area of the *building* times the *lighting power density*.

Table 1308.6.2.1
Lighting Power Densities Using the Building Area Method

Building Type	Lighting Power Density (W/ft^2)
Automotive Facility	1.5
Convention Center	1.4
Courthouse	1.4
Dining: Bar Lounge/leisure	1.5
Dining: Cafeteria/fast Food	1.8
Dining: Family	1.9
Dormitory	1.5
Exercise Center	1.4
Gymnasium	1.7
Hospital/healthcare	1.6
Hotel	1.7
Library	1.5
Manufacturing	2.2
Motel	2.0
Motion Picture Theatre	1.6
Multi-family	1.0
Museum	1.6
Office	1.3
Parking Garage	0.3
Penitentiary	1.2
Performing Arts Theater	1.5
Police/fire Station	1.3
Post Office	1.6
Religious Buildings	2.2
Retail	1.9
School/university	1.5
Sports Arena	1.5
Town Hall	1.4
Transportation	1.2
Warehouse	1.2
Workshop	1.7

1308.6.2.2 Space-by-Space Method of Calculating Interior Lighting Power Allowance: Use the following steps to determine the interior lighting power allowance by the space-by-space method:

1. For each space enclosed by partitions 80% or greater than ceiling height, determine the gross interior floor area by measuring to the center of the partition wall. Include the floor area of balconies or other projections. Retail spaces do not have to comply with the 80% partition height requirements.
2. Determine the *interior lighting power allowance* for each space from Table 1308.6.2.2. Multiply the floor area(s) of the space(s) times the allowed *lighting power density* for the space type that most closely represents the proposed use of the space(s). The product is the *lighting power allowance* for the space(s). For space types not listed, selection of a reasonable equivalent category shall be permitted.
3. The *interior lighting power allowance* is the sum of *lighting power allowances* of all spaces. Trade-offs among spaces are permitted provided that the total *installed interior lighting power* does not exceed the *interior lighting power allowance*.

Table 1308.6.2.2
Lighting Power Densities Using the Space-by-Space Method

Building Type	Area/Space Type	LPD (W/ft2)	Additional Power Allowances *
Common Space Types			
	Active Storage	1.1	
	Atrium - First Three Floors	1.3	
	Atrium - Each Additional Floor	0.2	
	Classroom/Lecture/Training	1.6	
	Conference/Meeting/Multipurpose	1.5	
	Corridor/Transition	0.7	
	Dining Area	1.4	
	Electrical/Mechanical	1.3	
	Food Preparation	2.2	
	Inactive Storage	0.3	
	Lobby	1.8	
	Lounge/Recreation	1.4	
	Office - Enclosed	1.5	
	Office - Open Plan	1.3	
	Restroom	1.0	
	Stairway	0.9	
	Laboratory	1.8	1
Athletics			
	Audience/Seating Area	0.5	
	Court Sports Area	4.3	
	Dressing/Locker/Fitting Room	0.8	
	Exercise Area	1.1	
	Indoor Playing Field	1.9	
	Playing Area	1.9	
	Ring Sports Area	3.8	
Transportation			
	Baggage Area	1.3	
	Terminal Concourse	0.7	1
	Ticket Counter	1.8	1
	Transportation Seating Area	1.0	
Hospitality & Food Service			
	Bar Lounge/Leisure Dining Area	1.2	
	Cafeteria/Fast Food Dining Area	1.4	
	Family Restaurant Dining Area	2.2	
	Hotel Lobby	1.7	
Government & Public Safety			
	Confinement Cell	1.1	
	Court House/Police Station Audience/Seating Area	1.6	
	Courtroom	2.1	1
	Fire Station Engine Room	0.9	
	Fire Station Sleeping Quarters	1.1	
	Judges Chamber	1.1	
	Penitentiary Audience/Seating Area	1.9	
	Penitentiary Classroom/Lecture/Training	1.4	
	Post Office Sorting Area	1.7	1
Hospital & Healthcare			
	Active Storage - Hospital	2.9	
	Corridors w/ Patient Waiting, Exam	1.6	
	Emergency	3.2	

Building Type	Area/Space Type	LPD (W/ft2)	Additional Power Allowances *
Hospital & Healthcare continued			
	Exam/Treatment	1.6	
	Laundry/Washing	0.7	
	Medical Supplies	3.0	
	Nurse Station	1.8	1
	Nursery	1.0	
	Operating Room	7.6	
	Patient Room	1.2	
	Pharmacy	2.3	
	Physical Therapy	1.9	
	Radiology	0.4	
	Recovery	2.6	
Industrial & Auto Service			
	Automobile Garage Service/Repair	1.4	
	Detailed Manufacturing	6.2	
	Manufacturing Control Room	0.5	
	Manufacturing Corridor/Transition	0.5	
	Manufacturing Equipment Room	0.8	
	Manufacturing General - High Bay	3.0	
	Manufacturing General - Low Bay	2.1	
	Workshop	2.5	
Library & Museum			
	Library Card File & Cataloguing	1.4	1
	Library Reading Area	1.8	1
	Library Stacks	1.9	1
	Museum Active Storage	1.4	
	Museum General Exhibition	1.6	
	Museum Inactive Storage	1.4	
	Museum Restoration	2.5	
Retail & Banking			
	Banking Activity Area	2.4	1
	General Retail Sales Area	2.1	1,2
	Mall Concourse	1.8	1
Public Assembly			
	Convention Center Audience/Seating Area	0.5	
	Convention Center Exhibit Space	3.3	
	Motion Picture Audience/Seating Area	1.3	
	Motion Picture Theatre Lobby	0.8	
	Performing Arts Audience/Seating Area	1.8	
	Performing Arts Theatre Lobby	1.2	
Religious			
	Religious Audience/Seating Area	3.2	
	Fellowship Hall	2.3	
	Worship - Pulpit, Choir	5.2	1
Warehouse & Parking			
	Fine Material Storage	1.6	
	Garage Parking Area - Attendant Only	0.1	
	Garage Parking Area - Pedestrian	0.2	
	Medium/Bulky Material Storage	1.1	

* Additional Power Allowances:

1. decorative luminaires, 1.0 W/ft^2
2. luminaires to highlight merchandise, 1.6 W/ft^2, 3.9 W/ft^2 for fine merchandise or for detailed display and examination

1308.6.2.3 Additional Interior Lighting Power: An increase in the *interior lighting power allowance* is allowed when using the Space-by-Space Method for specific space functions as noted in Table 1308.6.2.2. In all such spaces in which an additional lighting power allowance is taken, the additional power shall be allowed only if the specified lighting is installed. Additional power shall be used only for the specified *luminaires* and shall not be used for any other purpose or in any other space.

An increase in the *interior lighting power allowance* for space types noted in Table 1308.6.2.2 as eligible for additional *interior lighting power allowance*:

1. for spaces in which lighting is specified to be installed in addition to the general lighting for the purpose of decorative appearance, such as chandelier-type luminaries or sconces or for highlighting art or exhibits, provided that the additional lighting power shall not exceed 1.0 W/ft^2 of such spaces.
2. for lighting equipment installed in retail spaces that is specifically designed and directed to highlight merchandise provided that the additional lighting power shall not exceed:
    a. 1.6 W/ft^2 of the illuminated area, or
    b. 3.9 W/ft^2 of the illuminated area for displaying and selling fine merchandise such as jewelry, fine apparel and accessories, china, crystal and silver, art galleries, and similar spaces where the detailed display and examination of merchandise is important.

1308.7 Exterior Building Lighting Power: The exterior lighting power allowance is the sum of lighting power allowances for all of the applicable exterior applications permitted, other than building facades, provided that the total installed exterior lighting power does not exceed the exterior lighting power allowance. Exterior lighting for all other applications (except those included in the Exceptions to 780 CMR 1308.7) shall comply with the requirements of 780 CMR 1308.5.

Table 1308.7
Lighting Power Limits for Building Exteriors

Applications	Power Limits
Building entrance with canopy or free standing canopy	3 W/ft^2 of canopied area
Building entrance without canopy	33 W/lin ft of door width
Building exit	20 W/lin ft of door width
Building facades	0.25 W/ft^2 of illuminated *façade area*

Exceptions: Lighting used for the following exterior applications is exempt when equipped with an independent *control device*:

1. specialized signal, directional, and marker lighting associated with transportation;
2. lighting used to highlight features of public monuments and registered *historic* landmark structures or *buildings*;
3 lighting that is integral to advertising signage.

780CMR 1309.0 BUILDING DESIGN BY SYSTEMS ANALYSIS

1309.1 General: 780CMR 1309.0 establishes design criteria in terms of total energy use by a building including all of its systems.

A commercial or high rise residential building designed in accordance with 780CMR 1309.0 will be deemed as complying with 780CMR 13 if the annual energy consumption is not greater than if the building were designed with enclosure elements and energy consuming systems in compliance with 780CMR 1304.0 through 1308.0.

1309.2 Analysis Procedure: The analysis of the annual energy usage of the standard and the proposed alternative building and system design shall meet the following criteria:

1. Energy Analysis: The calculation procedure used to simulate the operation of the building and its service systems through a full year operating period shall be of sufficient detail to permit the evaluation of the effect of system design, climatic factors, operational characteristics, and mechanical equipment on annual energy usage. The calculation procedure shall be based upon 8760 hours of operation of the building and its service systems and shall utilize techniques recommended in the ASHRAE Handbook, 1997 Fundamentals Volume.
2. Climatic data: Coincident hourly data for temperatures, solar radiation, wind and humidity of typical days in the year representing seasonal variation, in accordance with Tables 1303.1 and 1303.2.
3. Energy Sources: Identical energy sources must serve the same purpose in both the standard and the proposed alternative design. If the proposed alternative design results in an increase in consumption of one energy source and a decrease in another energy source, each energy source shall be converted to equivalent Btu units for purposes of comparing the total energy used. Consumption of electricity shall be converted at the rate of 10,000 Btu/kWh for the purpose of this comparison.

4. Nondepletable Energy Sources: Energy collected on site from nondepletable sources shall be omitted from the comparison of total energy used. Energy collected off site from nondepletable sources shall be included in the comparison of total energy used.

5. Building Operation: Building operation shall be simulated for a full calendar year. Operating schedules shall include hourly profiles for daily operation and shall account for variations between weekdays, weekends, holidays, and any seasonal operation. Schedules shall model the time-dependent variations of occupancy, illumination, receptacle loads, thermostat settings, mechanical ventilation, HVAC equipment availability, service hot water usage, and any process loads.

> **Exception:** Operating schedules shall be permitted to differ between the proposed design and the standard design to allow simulation of the impact of any automatic control provided in the proposed design beyond the minimum requirements in 780 CMR 1304 through 1309.

6. Simulated Loads: The following systems and loads shall be modeled in determining total building performance: heating systems; cooling systems; fan systems; lighting power; receptacle loads; and process loads that exceed 1.0 watts per square foot of floor area of the room or space in which the process loads are located.

> **Exception:** Systems required for emergency power only.

7. Service Water Heating Systems: Service water heating systems that are other than combined service hot water/space heating systems shall be permitted to be omitted from the energy analysis provided all requirements of 780 CMR 1306 have been met.

8. Exterior Lighting: Where included in the analysis the exterior lighting systems shall be the same in the standard and proposed designs.

1309.3 Proposed Design: Building systems and loads shall be simulated in the proposed design as follows:

1. HVAC and Service Water Heating Equipment: All HVAC and Service Water Heating Equipment shall be simulated in the proposed design using capacities, rated efficiencies, and part-load performance data for the proposed equipment as provided by the equipment manufacturer.

2. Features Not Documented at Time of Permit: Any feature of the proposed design not included in the construction documents shall be assumed to be equal to the corresponding feature in the standard design.

3. Mandatory Requirements: The proposed design shall meet the requirements of the following without exception:
   a. 780 CMR 1304.1.2 Moisture Control
   b. 780 CMR 1304.2.7 Slabs on Grade
   c. 780 CMR 1304.2.8 Slabs Below Grade
   d. 780 CMR 1304.3 Air Leakage
   e. 780 CMR 1304.4 Insulation General
   f. 780 CMR 1305.3.4 Temperature and Humidity Controls
   g. 780 CMR 1305.3.8 & 9 Distribution System Construction and Insulation
   h. 780 CMR 1307.0 ELECTRIC POWER DISTRIBUTION
   i. 780 CMR 1308.2 Lighting Control

1309.4 Standard Design: The standard design, conforming to the criteria of 780 CMR 1309, and the proposed design, shall be designed on a common basis as specified herein. The comparison shall be expressed as Btu input per square foot of gross floor area per year.

The heating and cooling system zoning, orientation of each building feature, number of floors, and the gross envelope areas of the standard design shall be the same as those of the proposed design.

> **Exception:** Permanent fixed or movable external shading devices for windows and glazed doors shall be excluded from the standard design.

1309.5 Documentation: Proposed alternative designs, submitted as requests for exception to the standard design criteria, shall be accompanied by an energy analysis comparison report prepared by a professional registered engineer or registered architect. The report shall provide sufficient technical detail on the two buildings and systems designs, and on the data used in and resulting from the comparative analysis, to verify that both the analysis and the designs meet the criteria of 780 CMR 13. The documentation shall demonstrate that the analysis used is consistent with ASHRAE calculation procedures and accepted engineering practice.

> **Exception:** Proposed alternative designs for buildings having an area of 5,000 square feet or less and having the indoor temperature controlled from a single point are exempted from the full year energy analysis as described above. A comparison of energy consumption between the alternative design and the standard design shall be provided in a report prepared by a registered professional engineer or architect. Such analysis shall follow the bin or degree day methods or other simplified analysis procedures in ASHRAE 1997 Handbook of Fundamentals.

eight-foot-high assembly which shall be mounted in a vertical position.

1406.2.1.2 Test exposure and apparatus: The test exposure and apparatus shall conform to 780 CMR 1406.2.1.2.1 through 1406.2.1.2.4.

1406.2.1.2.1 Apparatus: A three-foot by three-foot propane-fired radiant panel shall be provided and shall operate at a constant temperature of 1,600°F (871°C) ± 50°F (28°C).

1406.2.1.2.2 Configuration: The radiant panel and the test specimen shall be configured in a parallel plate orientation such that the axis perpendicular to, and running through, the center of the radiant panel face and the test specimen are concurrent.

1406.2.1.2.3 Heat flux: The temperature of the radiant heat panel shall be fixed to produce an average heat flux of 12.5 ± 5% kW/m^2 over the center square foot of the test assembly. Average heat flux shall be determined as the average of four calorimeter readings located at the corners of the center square foot of the test assembly.

1406.2.1.2.4 Exposure: The four-foot by eight-foot test specimen shall be exposed to a "square wave" exposure for a period of 20 minutes. A spark igniter shall be installed and located at a point 18 inches vertically above the center point of the test specimen and $\frac{5}{8}$ inch off the face of the test specimen. The spark igniter shall be operated throughout the 20-minute test period. If the spark igniter is operated in an intermittent mode, the "off" portion of the cycle shall not be longer than two seconds and the "on" portion of each cycle shall be at least five seconds in duration.

1406.2.1.3 Conditions of acceptance: Materials shall qualify for installation under the provisions of 780 CMR 1406.2.1.3.1 or 1406.2.1.3.2.

1406.2.1.3.1 Unrestricted installation: For any *fire separation distance*, an assembly shall be acceptable for installation in accordance with 780 CMR 1406.0 and 780 CMR 1405.0 and 2603.6 if, during the exposure described in 780 CMR 1406.2.1.2, continuous flaming ignition does not occur for a time period greater than five seconds. Continuous flaming ignition shall be judged to occur when continuous flaming is visually observed by laboratory personnel for greater than five seconds.

1406.2.1.3.2 Restricted installation: For *fire separation distances* greater than five feet (1524 mm), an assembly shall be permitted with increased *fire separation distance* if a test specimen in accordance with 780 CMR 1406.2.1.1, while being exposed to a reduced level of incident radiant heat energy in accordance with 780 CMR 1406.2.1.2, meets the conditions of acceptance in 780 CMR 1406.2.1.3.1. The minimum *fire separation distance* required for the assembly shall be determined from Table 1406.2.1.3.2 based on the maximum tolerable level of incident radiant heat energy determined by 780 CMR 1406.2.1.3.2

1406.2.2 Construction requirements: Combustible *exterior wall finish*, other than fireretardant-treated wood complying with 780 CMR 2310.0 for exterior installation, shall not exceed 10% of an exterior wall surface area where the *fire separation distance* is five feet or less. In buildings of Types 1, 2, 3 and 4 construction, all architectural trim which exceeds 40 feet (12192 mm) in height above *grade plane* shall be constructed of approved noncombustible materials and shall be secured to the wall with metal or other approved noncombustible brackets.

Exception: Foam plastics, installed in accordance with 780 CMR 2603.6, as required, shall not be subject to these limitations.

Table 1406.2.1.3.2

MINIMUM FIRE SEPARATION DISTANCE FOR COMBUSTIBLE VENEERS BASED ON MAXIMUM TOLERABLE LEVEL OF INCIDENT RADIANT HEAT ENERGY

Fire Separation Distance (feet)[a]	Tolerable level incident radient heat energy (kW/m^2)	Fire separation distance (feet)[a]	Tolerable level incident radiant heat energy (kW/m^2)
5	12.5	16	5.9
6	11.8	17	5.5
7	11.0	18	5.2
8	10.3	19	4.9
9	9.6	20	4.6
10	8.9	21	4.4
11	8.3	22	4.1
12	7.7	23	3.9
13	7.2	24	3.7
14	6.7	25	3.5
15	6.3		

Note a. one foot = 304.8mm.

1406.2.3 Location: Where combustible *exterior wall finish* is located along the top of exterior walls, such trim shall be completely backed up by the exterior wall and shall not extend over or above the top of exterior walls.

1406.2.4 Firestopping: Continuous *exterior wall finish* constructed of combustible materials shall be *firestopped* as required in 780 CMR 720.0.

1406.3 Combustible half-timbering: In buildings of Types 3 and 4 construction which do not exceed three stories or 40 ft (12192 mm) in *height* above *grade plane*, exterior half-timbering and similar architectural decorations are permitted to be constructed of wood or other equivalent combustible material, provided that such trim is backed up solidly with approved noncombustible materials.

1406.4 Balconies and similar appendages: All balconies, porches, decks and supplemental exterior *stairways* attached to or supported by buildings of Types 1 and 2 construction shall be constructed of approved noncombustible materials. Such appendages attached to or supported by buildings of Types 3, 4 and 5 construction shall be of either noncombustible or combustible construction. Such appendages of combustible construction, other than fireretardant-treated wood, shall afford the fireresistance rating required by Table 602 for floor construction or shall be of Type 4 construction as described in 780 CMR 2304.0 and the aggregate length shall not exceed 50% of the building perimeter on each floor.

Exceptions:

1. Untreated wood is permitted for pickets and rails, or similar guardrail devices which are limited to 42 inches (1067 mm) in height.
2. Balconies and similar appendages on buildings of Types 3, 4 and 5 construction shall be permitted to be of Type 5 construction, and shall not be required to have a fireresistance rating where *sprinkler* protection is extended to these areas.

1406.5 Bay and oriel windows: A bay window is a window that projects beyond the wall line of a building and extends down to the foundation. All bay and *oriel windows* attached to or supported by walls in other than buildings of Type 5 construction, shall be of noncombustible construction and be framed with brackets of steel, concrete or other approved noncombustible materials.

Table 1606.1
MINIMUM UNIFORMLY DISTRIBUTED LIVE LOADS

Occupancy	Live load (psf)^a
Apartments (see Residential)	
Armories and drill rooms	150
Assembly areas & theatres:	
Fixed seats	60
Movable seats	100
Platforms (assembly)	100
Stage floors	150
Balcony, decks (exterior)	100
One-and two-family dwellings only	60
Bowling centers, poolrooms and billiard rooms	75
Cornices	60
Corridors, except as otherwise indicated	100
Dwellings (see Residential)	
Fire escapes	100
Single-family residential buildings only	40
Garages:	
Passenger cars	50
Trucks and buses - see also 780 CMR 1606.1.1	50
Grandstands (see Reviewing stands)	
Gymnasiums, main floors and balconies	100
Hospitals	
Operating Rooms Laboratories	100
Private Rooms	40
Wards	40
Corridors above first floor	80
Hotels (see Residential)	
Institutional - residential care (see Residential)	
Libraries:	
Reading Rooms	60
Stack rooms (books and shelves @ 40 pcf but not less than)	150
Manufacturing	
Light	125
Heavy	150
Marquees	75
Office buildings:	
Offices	50
Lobbies	100
Corridors, above first floor	80
File and computer rooms require heavier *loads* based upon anticipated occupancy	
Penal Institutions:	
Cell Blocks	40
Corridors	100
Residential:	
Attics - see 780 CMR 1606.1.2	20
Multiple - family dwellings:	
Dwelling units	40
Public rooms	100
Corridors	80
One-and two-family dwellings (areas other than sleeping rooms)	40
Sleeping rooms	30
Decks, balconies, etc.	60
Hotels:	
Guestrooms	40
Public rooms	100
Corridors serving public rooms	100
Corridors	80
Reviewing stands, grandstands and bleachers - see 780 CMR 1615.5	100
Schools	
Classrooms	50
Corridors	80
Flexible open plan areas	100
Sidewalks, vehicular driveways, subject to trucking	250
Skating rinks	100
Stairs and exits	100
Storage areas:	
Light	125
Heavy	250
Stores:	
Retail - 1st floor	100
Retail - upper flloors	75
Wholesale	100
Yards and terraces, pedestrians	100

Note a. 1 psf = 4.882 kg/m^2.

780 CMR 1607.0 DESIGN LIVE LOAD

1607.1 Required live load: The *live loads* to be assumed in the design of buildings and structures shall be the greatest *load* produced by the intended occupancy, but not less than the minimum uniformly distributed unit *loads* required in 780 CMR 1606.0 for specific use groups.

1607.2 Loads not specified: The code official shall approve the required *live load* for any occupancy not specifically provided for in Table 1606.1.

1607.3 Partial loading: The full intensity of the appropriately reduced live load applied only to a portion of the length of a structure or member shall be considered if such applied load produces a more unfavorable effect than the same intensity applied over the full length of the structure or member.

780 CMR 1608.0 LIVE LOAD REDUCTION

1608.1 General: The design live loads specified in 780 CMR 1607.0 may be reduced as permitted and specified herein, except that the design live load shall not be reduced on the following types of structural members:

1. One-way precast or cast-in-place solid, ribbed and hollow core concrete slabs.

   Exception: Ribs of ribbed or hollow core slabs may be treated as individual beams, and live load may be reduced on the ribs the same as for beams.

2. Two-way concrete flat slabs and grid slabs, with or without capitals or drop panels.

   Exception: live load may be reducted on slab panels if there are beams on all sides of the panels, and load is transferred to the columns from these beams entirely by "beam shear".

3. Hangers

1608.2 Design live loads of 100 psf or less: Except for places of public assembly (as defined in 780 CMR 210.) garages, and open parking structures, a structural member having a tributary area A_T that is greater than A_B may be designed for a reduced live load determined by the following formulas:

$$L = NL_O$$

N = the largest of the following:

1. $1 - 0.0008\,(A_T - A_B)$
2. $0.75 - 0.20\,(D_o/L_o)$
3. 0.50 for members supporting load from more than one floor, or 0.60 for members supporting load from one floor only, in which:

L = reduced design live load for the member
L_o = basic design live load
D_o = dead load on the member
A_T = loaded area tributary to the member, square feet
A_B = basic tributary area, square feet, defined as follows:
A_B = 100 square feet for members supporting load from more than one floor
A_B = 250 square feet for members supporting load from one floor only

1608.3 Design live loads greater than 100 psf and design live loads for garages and open parking structures: Structrual members supporting load from more than one floor may be designed for a reduced live load equal to 80% of the design live load.

1608.4 For determination of the number of floors supported by a member in 780 CMR 1608.1, 1608.2 and 1608.3 a roof may be considered to be a floor if the design live load of the roof is equal to or greater than the design live load of the floor below.

780 CMR 1609.0 ROOF LOADS

1609.1 General: The structural supports of roofs and marquees shall be designed to resist *wind* (see 780 CMR 1611.0) and, where applicable, snow (see 780 CMR 1610.0) and *earthquake loads* (see 780 CMR 1612.0) in addition to the *dead load* of construction and the appropriate *live loads* as prescribed in 780 CMR 1609.0, or in Table1606.1

1609.2 Definitions: The following words and terms shall, for the purposes of 780 CMR 1609.0 and as used elsewhere in 780 CMR, have the meanings shown herein.

Fabric awning: A fabric awning is an architectural projection that provides weather protection, identity or decoration and is wholly supported by the building to which it is attached. An awning is comprised of a lightweight, rigid or retractable skeleton structure over which a fabric cover is attached.

Fabric canopy: A fabric canopy is an architectural projection that provides weather protection, identity or decoration and is ground supported in addition to being supported by the building to which the canopy is attached. A canopy is comprised of a lightweight skeleton structure over which a fabric cover is attached. A fabric canopy is not a primary structure or a roof.

1609.3 Minimum roof loads: Ordinary roofs, either flat, pitched or curved, shall be designed for the *live loads* as specified in Table 1609.3 or the snow *load*, whichever is greater.

1609.4 Overhanging eaves: In other than occupancies in Use Group R-3, and except where the overhang framing is a continuation of the roof framing, overhanging eaves, cornices and other roof projections shall be designed for a minimum uniformly distributed *live load* of 60 psf (292.92 kg/m²).

Table 1609.3
MINIMUM ROOF LIVE LOADS[a]

Roof slope	Tributary loaded area in square feet[b] for any structural member		
	0 to 200	201 to 600	Over 600
Flat, or rise less than 4 inches per foot (1:3) Arch or dome with rise less than ⅛ of span	20	16	12
Rise 4 inches per foot (1:3) to less than 12 inches per foot (1:1) Arch or dome with rise ⅛ of span or less than ⅜ of span	16	14	12
Rise 12 inches per foot (1:1) and greater Arch or dome with rise ⅜ of span or greater	12	12	12

Note a: *loads* are expressed in pounds per square foot of horizontal projection
Note b: 1 square foot = 0.093 m^2·1 psf = 4.882 kg/m^2

1609.5 Ponding: Roofs shall be designed for the maximum possible depth of water that would pond thereon as determined by the relative levels of roof deck and overflow weirs, scuppers, edges or serviceable drains in combination with the deflected structural elements. In determining the maximum possible depth of water, all primary roof drainage means shall be assumed to be blocked.

1609.6 Special purpose roofs: Where occupied for incidental promenade purposes, roofs shall be designed for a minimum *live load* of 60 psf (292.92 kg/m²); and 100 psf (488.20 kg/m²) where designed for roof gardens or assembly or educational occupancies.

- Design of foundations that will not fail either by loss of bearing capacity or excessive settlement if liquefaction occurs.
- Replacement or densification of liquefaction-susceptible soils such that liquefaction will not occur.

4. For sites underlain by saturated sands where lateral sliding (slope instability) may occur, studies by a *registered design professional* shall be made to establish the safety against sliding during an earthquake with a peak acceleration of 0.12 g and a frequency content similar to that implied by the modal seismic design coefficient set forth in 780 CMR 1612.0
5. For sites underlain by saturated silty sands and inorganic non-plastic silts, studies shall be made by a *registered design professional* to determine the susceptibility to liquefaction of these soils.

1805.4 Vertical pressure: The computed vertical pressure at any level beneath a foundation shall not exceed the allowable bearing pressure for the material at that level. Computation of the vertical pressure in the bearing materials at any depth below a foundation shall be made on the assumption that the load is spread uniformly at an angle of 30° with the vertical; but the area considered as supporting the load shall not extend beyond the intersection of 30° planes of adjacent foundations.

1805.5 Settlement analysis: Whenever a structure is to be supported by medium or soft clay (materials of Class 10) or other materials which may be subject to settlement or consolidation, the settlements of the structure and of neighboring structures due to consolidation shall be given careful consideration, particularly if the subsurface material or the loading is subject to significant variation. The code official may require a settlement analysis to be made by a *registered design professional* when the *live* and *dead loads* of the structure, as specified in this article, minus the weight of the excavated material, induce a maximum stress greater than 300 pounds per square foot at mid-depth of the underlying soft soil layer.

Settlement analysis will be based on a computation of the new increase in stress that will be induced by the structure and realistically appraised *live loads*, after deducting the weight of excavated material under which the soil was fully consolidated. The effects of fill loads within the building area or fill and other loads adjacent to the building shall be included in the settlement analysis. The appraisal of the *live loads* may be based on surveys of actual *live loads* of existing buildings with similar occupancy. The soil compressibility shall be determined by a *registered design professional.*

1805.6 Disturbance of bearing materials: Whenever the bearing materials are disturbed from any cause, for example, by the inward or upward flow of water and/or by construction activities, the extent of the disturbance shall be evaluated by a *registered design professional* and appropriate remedial measures satisfactory to the code official shall be taken.

1805.7 Rock foundations: Where subsurface explorations at the project site indicate variations or doubtful characteristics in the structure of the rock upon which it is proposed to construct foundations, a sufficient number of borings shall be made to a depth of not less than ten feet below the level of the foundations to provide assurance of the soundness of the foundation stratum and its bearing capacity. Refer to Table 1804.3 for allowable bearing pressures and special conditions.

The maximum presumptive loadbearing capacity of Class 1 or Class 2 rock may be increased where the surface is leveled or benched, provided that such increased safe capacity is determined by load tests on an area of not less than one square foot (0.093 m^2) in accordance with the provisions of 780 CMR 1803.0.

780 CMR 1806.0 DEPTH OF FOOTINGS

1806.1 Frost protection: All permanent supports of buildings and structures larger than 100 square feet (9.3 m^2) in area or ten feet (3 m) in height shall extend to a minimum of four feet (1.2 m) below finished grade except when erected upon sound bedrock or when protected from frost, or when the foundation grade is established by a *registered design professional* and as approved by the code official. Spread footings of adequate size shall be provided where necessary to distribute properly the load within the allowable load bearing value of the soil. Footings shall not bear on frozen soils.

1806.2 Isolated footings: Footings on granular soil of Classes 7, 8 and 9 of Table 1804.3 and compacted fill shall be so located that the line drawn between the lower edges of adjoining footings shall not have a steeper slope than 30° (0.52 rad) with the horizontal unless the material supporting the higher footing is braced or retained or otherwise laterally supported in an approved manner or a greater slope has been properly established by a *registered design professional.*

1806.3 Depth of spread foundations: The bottom surface of any footing resting on material of Classes 5 through 10 of Table 1804.3, shall be at least 18 inches (460 mm) below the lowest ground surface or the top surface of a floor slab bearing directly on the soil immediately adjacent to the footing.

780 CMR 1807.0 FOOTING DESIGN

1807.1 Design loads: The loads to be used in computing the pressure upon bearing materials directly underlying foundations shall be the *live* and *dead loads* of the structure, as specified in 780 CMR 1616.0 including the weight of the foundations and of any immediately overlying material, but deducting from the resulting pressure per square foot the total weight of a one-foot-square column of soil, including the water in its voids, which extends from the lowest immediately adjacent surface of the soil to the bottom of the footing, pier or mat. Foundations shall be constructed so as to resist the maximum probable hydrostatic pressures.

1807.2 Vibratory loads: Where machinery operations or other vibrations are transmitted through the foundation, consideration shall be given in the footing design to prevent detrimental disturbances of the soil.

1807.3 Varying unit pressures: Footings shall be so designed that the unit soil pressure under the *dead load* shall be as uniform as possible under all parts of the building structure. When necessary for stability in the structure due to settlement or varying soil conditions, approved variations are permitted in the unit pressure under different footings.

1807.4 Eccentric loads: Eccentricity of loadings in foundations shall be fully investigated, and the maximum pressure on the basis of straight-line distribution shall not exceed the allowable bearing pressures.

1807.5 Protection of footings: Trenching installed parallel to footings shall not extend below the line of a 45° (0.79 rad) angle downward from the loadbearing plane of the footing.

780 CMR 1808.0 TIMBER FOOTINGS AND WOOD FOUNDATIONS

1808.1 Timber footings: Timber footings are permitted for buildings of Type 5 construction and as otherwise approved. Such footings shall be treated in accordance with AWPA C2 or C3 listed in *Appendix A*. Treated timbers are not required where placed entirely below permanent water level, or where used as capping for wood piles which project above the water level over submerged or marsh lands. The compressive stresses perpendicular to grain in untreated timber footings supported upon piles shall not exceed 70% of the allowable stresses for the species and grade of timber as specified in NFoPA NDS listed in *Appendix A*.

1808.2 Pole buildings: Pole-type buildings shall be designed and erected in accordance with AWPI *Pole Building Design* listed in *Appendix A*. The poles shall be treated in accordance with AWPA C2 or C4 listed in *Appendix A*.

1808.3 Wood foundations: Wood foundation systems shall be designed and installed in accordance with NFoPA TR7 listed in *Appendix A*. All lumber and plywood shall be treated in accordance with AWPA C22 listed in *Appendix A* and shall be identified in accordance with 780 CMR 2311.3.1.

780 CMR 1809.0 STEEL GRILLAGES

1809.1 General: All steel grillage beams shall be separated with approved steel spacers and shall be entirely encased in at least three inches (76 mm) of concrete, and the spaces between the beams shall be completely filled with concrete or cement grout. Where used on yielding soils, steel grillages shall rest on approved concrete beds not less than six inches (152 mm) thick.

780 CMR 1810.0 CONCRETE FOOTINGS

1810.1 Concrete strength: Concrete in footings shall have a specified compressive strength of not less than 2,500 psi (1.76 kg/mm^2) at 28 days.

1810.2 Design: Concrete footings shall comply with 780 CMR 19 and ACI 318 or ACI 318.1 listed in *Appendix A*.

1810.2.1 Footing seismic ties: Individual spread footings, located on soil profile type S2, S3 or S4, in accordance with 780 CMR 1612.4.2, and supporting buildings assigned to *Seismic Performance Category D*, in accordance with 780 CMR 1612.2.7, shall be interconnected by ties. All ties shall be capable of resisting, in tension or compression, a force equal to 10% of the larger column *dead plus live load*. Individual tie beams are not required when it is demonstrated that equivalent restraint will be provided by structural members within slabs on grade or reinforced concrete slabs on grade or confinement be competent rock, hard cohesive soils, very dense granular soils or other approved means.

1810.3 Thickness: The thickness of concrete footings shall comply with 780 CMR 1810.3.1 and 1810.3.2.

1810.3.1 Plain concrete: In plain concrete footings, the edge thickness shall not be less than eight inches (203 mm) for footings on soil; except that for occupancies of Use Group R-3 and buildings less than two stories in *height* of Type 5 construction, the required edge thickness shall be six inches (152 mm) provided that the footing does not extend beyond four inches (102 mm) on either side of the supported wall.

1810.3.2 Reinforced concrete: In reinforced concrete footings, the thickness above the bottom reinforcement shall not be less than six inches (152 mm) for footings on soil. The clear cover on reinforcement where the concrete is cast against the earth shall not be less than three inches (76 mm). Where concrete is exposed to soil after constructed cross-sectional area may be larger.) The reinforcing shall be placed in the top ⅓ of the pier length or extend ten feet (3 m) from the top of the pier, whichever is the longer length.

For *Seismic Performance Category C* buildings, the pier reinforcing shall be a minimum of four longitudinal bars with closed ties, or equivalent spirals, having a minimum diameter of ¼ inch. The ties shall be provided at a maximum spacing of 16 times the longitudinal reinforcing bar diameter and shall enclose an area of concrete sufficient to confine the minimum design cross-sectional concrete area. The maximum tie spacing in the top two feet (0.6 m) of the pier length shall be four inches (102 mm). Tie detailing shall be in accordance with 780 CMR 1903.4.

For *Seismic Performance Category D* buildings, the pier reinforcing shall be a minimum of four longitudinal bars with closed ties, or equivalent spirals, having a minimum diameter of ⅜ inch, for piers with a diameter of 20 inches (508 mm) or less; and a minimum tie diameter of ½ inch, for piers with a diameter more than 20 inches (508 mm). The ties shall be provided at a maximum spacing of eight times the longitudinal reinforcing bar diameter. The maximum tie spacing in the top four feet (1.2 m) of the pier length shall be three inches (76 mm). Tie detailing shall be in accordance with 780 CMR 1903.5.

Exception: Pier ties or spirals are not required where permanent metal casing (steel pipe, steel tube or spiral-welded steel shell) is used, provided the casing has minimum thickness as follows: for *seismic Performance Category C* buildings, 0.058 inch (1.5 mm), and for *Category Performance Category D* buildings, 0.070 inch (1.8 mm). The steel casing must be adequately protected from corrosion due to soil, changing water levels, or other subgrade conditions indicated by the site soil investigation.

1815.2.3 Pier cap connection: All piers shall be connected to the pier cap so that pier reinforcement is embedded in the cap for a distance equal to the development length as specified in ACI 318 listed in *Appendix A*. Field-placed dowels anchored in the concrete piers are acceptable. The development length to be provided is the full development length of the reinforcement for compression without reduction in length for excess area.

1815.2.4 Alternative detailing: Alternative measures for laterally confining concrete and maintaining toughness and ductile-like behavior at the top of the pier shall be permitted provided consideration is given to forcing the hinge to occur in the confined region.

1815.3 Installation: In unstable soils, a temporary casing or slurry shall be used to stabilize the excavation. When a slurry is used to stabilize the excavation, the level and quality of the slurry shall be monitored and controlled to maintain stability of the shaft and the bearing surface.

1815.4 Enlarged bases: Bell-shaped bases shall have a minimum edge thickness of four inches (102 mm). The bell roof shall slope not less than 60° with the horizontal unless the base is designed in accordance with ACI 336 listed in ***Appendix A*** (hereinafter ACI 336).

1815.5 Placement of concrete: Concrete may be dropped into the pier from the ground surface provided no more than three inches (76 mm) of water remains in the bottom and the concrete will free-fall vertically without obstruction. The concrete shall be placed in a rapid, continuous operation and controlled such that the concrete does not segregate.

1815.5.1 No piers shall be installed near a concreted pier until the concrete has set sufficiently to avoid damage to the concreted pier.

1815.5.2 For piers without enlarged bases, concrete or grout may be placed through still water or slurry. A properly operated tremie or pumping method shall be used. Samples of the slurry shall be tested to determine the properties prior to placing concrete in each pier. The quality, consistency, and density of the slurry shall be controlled to ensure that there will be free-flow of concrete from the tremie pipe. The concrete must be placed such that all water, slurry and contaminated concrete below design cutoff level is displaced.

1815.5.3 For piers with enlarged bases, the concrete may be placed under slurry, based upon the recommendations of a *registered design professional* and with the approval of the code official. The specific soil or rock conditions, equipment and procedures used shall be taken into account.

1815.5.4 A suitable method shall be employed to verify that the entire length of the shaft is completely filled with concrete. Such means shall include the ability to determine the incremental volumes of concrete installed in relation to calculated shaft volume.

1815.6 Design stresses: Foundation piers may be designed as concrete columns with continuous lateral support below the soil level. The unit compressive stress in the concrete shall not exceed 33% of the 28 day strength of the concrete or 1,600 psi, whichever is less. The unit compressive stress in the steel reinforcement or the permanent steel casing shall not exceed 40% of the yield strength of the steel or 24,000 psi, whichever is less. Permanent steel casing which is used as structural reinforcement shall be protected against corrosion in accordance with 780 CMR 1816.4.1.

1815.7 Alignment: When the center of the cross section of a foundation pier at any level deviates from the resultant of all forces more than 1/50 of its height, or more than 1/10 of its diameter, it shall be reinforced as provided in ACI 336. The restraining effect of the surrounding soil may be taken into account.

1815.8 Allowable bearing pressure: The allowable bearing pressure on the bottom of the pier shall be in accordance with 780 CMR 1804.3 Additional load may be carried by using higher bearing pressures than allowed by 780 CMR 1804.3 and/or by friction on the sides of the pier embedded in suitable bearing material based on recommendations by a *registered design professional* and subject to the approval of the code official. Such recommendations shall be based on the results of load tests or other suitable tests or analyses carried out to measure side friction and/or end bearing of piers installed in the same bearing stratum.

1815.9 Minimum spacing: The minimum center-to-center spacing between adjacent piers designed for friction support shall be not less than two times the shaft diameter.

1815.10 Special provisions: For piers with shaft diameter less than 24 inches (610 mm), the following special provisions shall apply:

1815.10.1 For piers with temporary casing extending to the bottom, the concrete may be poured from the top in accordance with 780 CMR 1815.5.

1815.10.2: For all other cases, piers shall be filled from the bottom upward through a tremie or concrete pump tube in accordance with 780 CMR 1815.5.2

1815.11 Records: The owner shall engage a *registered design professional* to monitor the installation of the piers. The design professional or his representative, qualified by training and experience, shall be present at all times while foundation piers are being installed, to observe and test the bearing material in place, to verify the pier dimensions and to observe concrete placement. When direct inspection of the bearing surface is impossible, a suitable method shall be employed to verify the condition of the bearing material and to make the measurements and tests. Records of all observations, tests and dimensions shall be signed by the *registered design professional* and a copy shall be filed in the office of the code official.

780 CMR 1816.0 PILE FOUNDATIONS

1816.1 Investigation: Pile foundations shall be designed and installed on the basis of a foundation investigation and report conducted in accordance with 780 CMR 1802.0. The investigation shall include borings, test pits or other subsurface explorations at locations and depths sufficient to determine the position, thickness and adequacy of the loadbearing soils and demonstrate that there are no compressible soil deposits below the bearing stratum which would adversely affect the structure, *except* where sufficient data upon which to base the design and installation are available from other sources. In addition, the building site shall be investigated for all conditions which might promote deterioration of pile foundations, in order to satisfy the requirements of 780 CMR 1816.4. The investigation and report shall include, but not be limited to, the following:

1. Recommended pile types and installed capacities;
2. Driving criteria;
3. Installation and field inspection procedures;
4. Pile load test requirements;
5. Durability of pile materials; and
6. Designation of loadbearing stratum or strata.

1816.2 Special piles: Types of piles not specifically covered by the provisions of 780 CMR 1816.0 may be permitted, subject to the approval of the code official, upon the submission of acceptable test data and design and construction information prepared by a *registered design professional* stating that the pile installation is adequate to fulfill the design requirements.

1816.3 Seismic Design

1816.3.1 Seismic reinforcement: Piles shall have minimum longitudinal reinforcement and confining reinforcement in accordance with the provisions for specific pile types set forth in 780 CMR 1818.0 through 780 CMR 1824.0.

Where a minimum length for reinforcement or the extent of closely spaced confinement reinforcement is specified at the top of the pile, provisions shall be made so that those specified lengths or extents are maintained after pile cutoff.

Where seismic reinforcement at the top of the pile is required, alternative measures for laterally confining concrete and maintaining toughness and ductile-like behavior at the top of the pile shall be permitted provided consideration is given to forcing the hinge to occur in the confined region.

1816.3.2 Pile bending seismic design: Piling for buildings assigned to *Seismic Performance Category D*, in accordance with 780 CMR 1612.2.7, shall be designed for the maximum imposed curvatures resulting from seismic forces on free-standing piles where the piles are located in loose granular soils or in soil-profile type S3 or S4, in accordance with 780 CMR 1612.4.1. The piles shall be designed and detailed in accordance with the special moment frame requirements of 780 CMR 1903.3.3 or 780 CMR 2203.2 for a length equal to 120% of the flexural length. The flexural length shall be the distance from the point of fixity to the pile cap.

1816.3.3 Pile cap seismic connection: Piles shall be connected to the pile caps in accordance with the provisions for specific pile types set forth in 780 CMR 1818.0 through 780 CMR 1824.0.

1816.3.4 Pile foundation seismic ties: Piles or pile caps shall be interconnected by ties capable of resisting, in tension or compression, a force equal to 10% of the larger column dead plus live load. Individual tie beams are not required when it is demonstrated that equivalent restraint will be provided by structural members within slabs on grade or reinforced concrete slabs on grade or confinement by competent rock, cohesive soils, dense granular soils or other approved means.

1816.4 Protection of pile materials: Where boring records, previous experience, or site conditions indicate possible deleterious action on pile materials because of soil constituents, changing water levels or other factors, the pile materials shall be adequately protected by approved materials, methods or processes. Protective materials shall be applied to the piles so as not to be rendered ineffective by driving.

1816.4.1 Steel and steel-concrete piles: At locations where steel and steel-concrete piles will be in contact with any material which is corrosive to the steel, one of the following procedures shall be used for protection, or any other method which will satisfy the requirements of the code official:

1. Remove all objectionable material.
2. Effectively protect the steel surface from pile cutoff grade to a grade 15 feet (4.6 m) below the bottom of the objectionable material by means of:
   a. cathodic protection as approved by the code official;
   b. an approved encasement of not less than three inches (76 mm) of dense concrete;
   c. an effective protective coating subject to the approval of the code official; or
   d. providing an excess steel thickness of ⅛ inch (3.2 mm) beyond design requirements on all exposed steel surfaces.

1816.4.2 Timber piles: The preservative treatment of timber piles shall comply with the provisions of 780 CMR 1822.2.

1816.5 Lateral support: Any soil shall be deemed to afford sufficient lateral support to permit the design of any type of pile as a short column. When piles are driven through soil which will be removed subsequent to the completion of the foundation, the resistance offered by such material shall not be considered to contribute to the lateral supporting capacity.

1816.5.1 Column action: The portion of a pile that is not laterally supported shall be designed as a column in accordance with 780 CMR 19 taking into consideration the conditions of end fixity.

1816.6 Group action: In cohesive soils, the compressive load capacity of a group of friction piles shall be analyzed by a generally accepted engineering method, and, where such analysis indicates, the individual allowable pile load shall be reduced accordingly.

1816.7 Stability:

1816.7.1 Wall foundations: All piles in wall foundations shall be staggered about the center of gravity of the wall load at a minimum distance of ½ the pile top diameter therefrom. A foundation wall restrained laterally so as to ensure stability both during and after construction may be supported by a single row of piles.

1816.7.2 Columns: Individual columns supported on piles shall be designed for eccentricity between the column and the centroid of the supporting piles equal to a minimum of three inches (76 mm) or the actual eccentricity, whichever is greater. The design shall account for such eccentricity through one of the following methods:

a. By supporting the column on a minimum of three piles in a triangular pattern.
b. By designing walls, grade beams or structural floors to resist the bending moment induced by the eccentricity.
c. By designing the piles, column or both to resist the bending moment induced by the eccentricity and providing adequate lateral restraint at the top of the piles to resist the lateral thrust due to the bending moment.

1816.8 Structural integrity: Piles shall be installed in such a manner and sequence as to prevent distortion or damage to piles being installed or already in place, to the extent that such distortion or damage affects the structural integrity of the piles.

When piles have been damaged in driving, or have been driven in locations and alignment other than those indicated on the plans, or have capacities less than required by the design, the affected pile groups and pile caps shall be investigated, and if necessary, the pile groups or pile caps shall be redesigned or additional piles shall be driven to replace the defective piles.

1816.9 Spacing: The minimum center-to-center spacing of piles shall be not less than twice the average diameter of a round pile, nor less than 1¾ times the diagonal dimension of a rectangular pile. When driven to or penetrating into rock, the spacing shall be not less than 24 inches (610 mm). When receiving principal support from end-bearing on materials other than rock or through frictional resistance, the spacing shall be not less than 30 inches (762 mm) or as provided in 780 CMR 1820.4.6 for Pressure Injected Footings.

1816.10 Splices: Splices shall be avoided insomuch as practicable. When used, slices shall be constructed so as to provide and maintain true alignment and position of the component parts of the pile during installation and subsequent thereto, and shall be of adequate strength to transmit the vertical and *lateral loads* and moments occurring at the location of the splice during driving and under service loading. Splices shall develop not less than 50% of the capacity of the pile in bending. Additionally, all pile splices occurring in the upper ten feet (3 m) of the embedded portion of the pile shall be capable of resisting at allowable working stresses the moment and shear that results from an assumed eccentricity of the pile load of three inches (76 mm); or the pile shall be braced in accordance with 780 CMR 1816.7 to other piles that do not have splices in the upper ten feet (3 m) of embedment.

1816.11 Pile caps: Pile caps shall be of reinforced concrete. The soil immediately below the pile cap shall not be considered as carrying any vertical load. The tops of all piles shall be embedded not less than three inches (76 mm) into pile caps, and the caps shall extend at least four inches (102 mm) beyond the edges of all piles. The tops of all piles shall be cut back to sound material before capping.

1816.12 Pre-excavation: Jetting, augering and other methods of pre-excavation must be approved by the code official and carried out in the same manner as used for piles subject to load test and in a manner which will not impair the carrying capacity of the piles already in place or the safety of existing adjacent structures. Pre-excavation shall be of the same method as carried out on piles subject to load tests. Immediately after completion of jetting or augering, the pile shall be advanced to the maximum depth of pre-excavation and driven below this depth to the required load resistance. Where load tests are required, pre-excavation of test piles will be of the same manner as proposed for production piles.

1816.13 Inspection: The owner shall engage a *registered design professional* who shall submit his qualifications in writing to the code official. This design professional, or his representative, who must be qualified by experience and training, shall be present at all times while piles are being driven to observe all work in connection with the piles. The design professional or his representative shall make an accurate record of the material and the principal dimensions of each pile, of the weight and fall of the ram, the type, size and make of hammer, cushion blocks, the number of blows per minute, the energy per blow, the number of blows per inch for the last six inches (150 mm) of driving, together with the grades at point and cutoff and any other pertinent details. A copy of these records shall be signed by the *registered design professional*, and filed in the office of the code official.

1816.14 Identification: All pile materials shall be identified for conformity to the specified grade with this identification maintained continuously from the point of manufacture to the point of installation or shall be tested by an *approved agency* to determine conformity to the specified grade and the *approved agency* shall furnish an affidavit of compliance to the code official .

1816.15 Pile location plan: A plan showing the location and designation of all piles by an identification system shall be filed with the code official prior to installation of such piles. All detailed records for individual piles shall bear an identification corresponding to that shown on the plan.

1816.16 Use of existing piles: Piles that have previously supported a partially or fully demolished structure shall not be used for support of new construction unless satisfactory evidence is submitted to the code official which indicates that the piles have not been adversely impacted by the demolition, are sound, have adequate capacity to support the new design loads, and meet all of the requirements of 780 CMR. The capacities of such piles shall be determined by analyses, load testing or redriving. The design load applied to such piles shall not exceed the greater of the following values:

a. actual sustained load determined to have been previously supported satisfactorily by the piles, up to a maximum of 120 tons

b. the documented, as-built design capacity of the piles, as confirmed by prior load testing

c. design capacity determined by analyses and confirmed by new load testing or by redriving per 780 CMR 1817.3.1 on one or more piles representative of each configuration (s) of pile and subsurface conditions.

1816.17 Pile driveability: Pile cross sections shall be of sufficient size and strength to withstand handling and driving stresses without damage to the pile and to provide sufficient stiffness to transmit the required driving forces. Driven piles of uniform cross section or tapered piles shall have a minimum nominal diameter of eight inches (200 mm) except as provided in 780 CMR 1820.6.4 for small diameter grouted piles, 780 CMR 1822.3.3 for timber piles and 780 CMR 1821.1 for precast concrete piles. Tapered shoes or points of lesser dimensions may be attached to the pile unit.

1816.18 Pile heave: Adequate provision shall be made to observe pile heave. Accurate reference points shall be established on each pile immediately after installation; for cast-in-place piles with unfilled corrugated shells, the reference point shall be at the bottom of the pile. If, following the installation of other piles in the vicinity, heaving of ½ inch (13 mm) or more occurs, the heaved piles shall be re-driven to develop the required capacity and penetration, or the capacity of the pile may be verified by load tests in accordance with 780 CMR 1817.4.

Standard Method of Testing Piles Under Static Axial Compressive Load, except that Section 5, Loading Procedures, shall be deleted and replaced by the following provisions:

1. Apply 25% of the allowable design load every ½ hour. Longer time increments may be used, but each time increment should be the same. In no case shall a load be changed in the rate of settlement is not decreasing with time.
2. At 200% of the allowable design load (or 150% for pile groups), maintain the load for a minimum of one hour and until the settlement (measured at the lowest point on the pile at which measurements are made) over a one-hour period is not greater than 0.01 in.
3. Remove 50% of the design load every 15 minutes until zero load is reached. Longer time increments may be used, but each should be the same.
4. Measure rebound at zero load for a minimum of one hour.
5. For each load increment or decrement, take readings at the top of the pile and on the internal instrumentation at one, two, four, eight and 15 minutes and at 15-minute intervals thereafter.

A load greater than 200% of the allowable design load (or 150% of the allowable design load for pile groups) may be applied at the top of the pile, using the above loading procedure, to ensure that 780 CMR 1817.4.1 is fulfilled. Other optional methods listed in ASTM D1143 may be approved by the code official upon submittal in advance of satisfactory justification prepared by a *registered design professional* who is qualified in this field.

1817.4.4 Selection of design load: Provided that the allowable design load does not exceed the load allowed in 780 CMR 1817.0 for the type of pile and provided that the allowable design load does not exceed 100% of the load supported in the bearing stratum (or ⅔ of the load supported in the bearing stratum for friction piles or pile groups) when the maximum test load is applied, then the allowable design load shall be the greater of the following:

1. Allowable design load based on settlement during loading: 50% of the applied test load which causes a gross settlement at the pile cutoff grade equal to the sum of: a) the theoretical elastic compression of the pile in inches assuming all the load on the butt is transmitted to the tip, plus b) 0.15 inch (3.8 mm), plus c) 1% of the pile tip diameter or pile width in inches. If the settlements are so small that the load-settlement curve does not intersect the failure criterion, the allowable design load shall be 50% of the maximum test load.
2. Allowable design load based on the net settlement after rebound: 50% of the applied test load which results in a net settlement at the top of the pile of ½ inch (13 mm) after rebound for a minimum of one hour at zero load.

1817.5 Use of higher allowable stresses: Higher stresses than those permitted in 780 CMR 1817 for various pile materials may be approved by the code official based upon the submission of substantiating data and analyses which justify such higher stresses. The data shall be presented in a report prepared by a *registered design professional* experienced in geotechnical aspects of foundation design and shall include, as applicable: the results of the soil investigation, dynamic analyses of the pile behavior, pile load tests, analyses of load transfer during testing and prediction of pile performance during long term service.

1817.6 Lateral load tests: The allowable load on piles subject to *lateral load* shall be verified by test unless it is waived by the code official. Pile load tests may be waived by the code official, where justified, upon submittal of substantiating data which include experience and/or performance records for pile installations under similar soil and loading conditions prepared by a *registered design professional* experienced in geotechnical aspects of foundation design.

1817.6.1 Required test load: A single pile shall be load tested to not less than 200% of the design *lateral load*.

1817.6.2 Test setup and loading procedure: The load test setup instrumentation and loading procedure shall be in accordance with ASTM D3966 listed in *Appendix A*.

1817.6.3 Selection of design load: The design load shall be selected by the responsible *registered design professional*, based upon interpretation of the load-deflection data from the load test.

1817.7 Tension load tests: The allowable load on piles in tension shall be verified by test unless it is waived by the code official. Pile load test may be waived by the code official, where justified, upon submittal of substantiating data which includes experience and/or performance records for pile installations under similar soil and loading conditions prepared by a *registered design professional* experienced in the geotechnical aspects of foundation design.

1817.7.1 Required load test: A single pile or a pile group shall be load tested to not less than 200% of the design load for transient loads (i.e.: earthquake and wind) and 250% for sustained loads.

1817.7.2 Test setup and loading procedure: The load test setup, instrumentation and loading procedure shall be in accordance with ASTM D3689.

1817.7.3 Selection of design load: Provided the allowable design load does not exceed the allowable stresses in the pile materials, the allowable design load shall be the lower of the following:

1. 50% (for transient loads) or 40% (for sustained loads) of the applied test load which results in a net upward movement of ½ inch at the top of the pile after removal of the maximum test load (The gross upward movement minus the rebound movement).
2. 50% (for transient loads) or 40% (for sustained loads) of the applied test load which results in continuous upward movement with no increase in load.

1817.8 Bearing capacity: Individual piles and groups of piles shall develop ultimate load capacities of at least twice the design working loads in the designated bearing layers. Where weaker materials underlie the load bearing material into which the piles are driven, the allowable pile load shall be limited by the provision that the vertical pressures in such underlying materials produced by the loads on all piles in a foundation shall not exceed the allowable bearing pressures of such materials as provided in Table 1804.3 or as established by analysis, applying accepted principles of soil mechanics. Piles or pile groups shall be assumed to transfer their loads to the underlying materials by spreading the load uniformly at an angle of 60° with the horizontal, starting at a polygon circumscribing the piles at the top of the satisfactory bearing material in which they are embedded; but the area considered as supporting the load shall not extend beyond the intersection of the 60° planes of adjacent piles or pile groups.

1817.9 Bent piles: The load bearing capacity of piles discovered to have a sharp or sweeping bend shall be determined by an approved method of analysis or by load testing a representative pile.

1817.10 Overloads on piles: The maximum compressive load on any pile due to mislocation shall not exceed 110% of the allowable design load.

780 CMR 1818.0 STRUCTURAL STEEL PILES

1818.1 Materials: Structural steel piles and fully welded steel piles fabricated from plates shall conform to ASTM A36, A252, A283, A572 or A588 listed in *Appendix A*.

1818.2 Allowable stress: The allowable design compressive stress shall not exceed 35% of the minimum specified yield strength of the steel nor 12,600 psi. The maximum allowable design stress shall be limited to 50% of the minimum specified yield strength of the steel where higher stresses are substantiated by 780 CMR 1817.5.

1818.3 Pile cap seismic connection: All structural steel piles shall be connected to the pile cap with a connection detail designed for a minimum tensile force equal to 10% of the pile compression design *load.*

1818.4 Dimensions of H-piles: Sections of H-piles shall comply with the criteria of 780 CMR 1818.4.1 through 1818.4.4.

1818.4.1 Flanges: The flange projections shall not exceed 14 times the minimum thickness of metal in either the flange or the web, and the flange widths shall not be less than 80% of the depth of the section.

1818.4.2 Depth: The nominal depth in the direction of the web shall not be less than eight inches.

1818.4.3 Thickness: Flanges and webs shall have a minimum nominal thickness of ⅜ inch (9.5 mm).

1818.4.4 Tip reinforcement: The tips of all steel H piles having a thickness of metal less than 5/10 inches (12.7 mm) which are driven to end bearing on rock of Classes 1 through 3 by an impact hammer shall be reinforced. The installation of all steel H piles by impact hammer to end bearing on rock of Classes 1 through 3 shall be conducted so as to terminate driving when the pile reaches refusal on the rock surface.

780 CMR 1819.0 CONCRETE-FILLED STEEL PIPE AND TUBE PILES

1819.1 Material: Steel pipe and tube piles shall conform to ASTM A252 or A283 listed in Appendix A. Concrete shall conform to 780 CMR 1820.1.1.

1819.2 Allowable stress:

1819.2.1 Top driven piles: The allowable design compressive stress in the concrete shall not exceed 25% of the 28-day compressive strength of the concrete or 1,100 pounds per square inch whichever is smaller. The maximum allowable compressive stress in the steel shall not exceed 9,000psi.

1819.2.2 Mandrel driven piles: For piles installed with mandrels which transmit driving stresses to the bottom of the steel pipe, the allowable design compressive stress in the concrete shall not exceed 33% of the 28-day specified compressive strength. The allowable design compressive stress in the steel shall not exceed 35% of the minimum specified yield strength of the steel. The maximum allowable design stress shall be limited to 50% of the minimum specified yield strength of the steel where higher stresses are substantiated by 780 CMR 1817.

1819.3 Reinforcement: Except for steel dowels embedded five feet (1.5m) or less in the pile and as provided for in 780 CMR 1802.2 and 1802.6, reinforcement, where required, shall be assembled and tied together and shall be placed in the pile as a unit before the reinforced portion of the pile is filled with concrete.

1819.3.1 Seismic reinforcement: All pipe piles shall have over their full length a minimum area of steel, after allowance for corrosion, of 0.25 percent of the pile cross-sectional area for buildings assigned to *Seismic Performance Category C,* and a minimum area of steel of 0.50 percent for buildings assigned to *Seismic Performance Category D,* in accordance with 780 CMR 1612.2.7.

1819.3.2 Pile cap seismic connection: All concrete-filled steel pipe and tube piles shall be connected to the pile cap by providing longitudinal reinforcement at the top of the pile equal to 1 % of the pile cross-sectional area. The reinforcement shall extend into the pile for a length equal to two times the required embedment anchorage into the pile cap. The embedment in the pile cap shall equal the development length as specified in ACI 318 as listed in Appendix A. The development length to be provided in the cap is the full development length for compression without reduction in length for excess area. Field-placed dowels anchored in the concrete are acceptable.

NON-TEXT PAGE

1819.4 Minimum dimensions: Piles shall have a nominal outside diameter of not less than eight inches (203 mm) and a minimum wall thickness of 1/10 inch (2.5 mm), except that for piles driven open ended, the nominal outside diameter shall not be less than ten inches (254 mm) and the wall thickness not less than ¼ inch (6.4 mm) for diameters less than 14 inches (356 mm) and ⅜ inch (9.5 mm) for diameters greater than 14 inches. Pipe of lesser wall thickness may be used if a suitable cast steel cutting shoe is provided.

1819.5 Placing concrete: The placement of concrete shall conform to 780 CMR 1820.1.3 and 1820.5.

780 CMR 1820.0 CAST-IN-PLACE CONCRETE PILES

1820.1 General: 780 CMR 1820.0 includes augered uncased piles, pressure injected footings (enlarged base piles), cased poured piles, and small diameter grouted piles. Unless otherwise noted, the materials, reinforcing and installation shall conform to 780 CMR 1820.1.1 through 1820.1.3.

1820.1.1 Material: All concrete shall have a 28-day specified compressive strength (f'_c) of not less than 3,000 psi (2.11 kg/mm^2). The maximum size of coarse aggregate for all concrete shall be ¾ inch (19 mm), and the concrete shall have a slump of four to seven inches (102 mm to 178 mm). If concrete is to be pumped, the mix design including slump shall be adjusted to produce a pumpable concrete.

1820.1.2 Reinforcement: Except for steel dowels embedded five feet (1.5 m) or less in the pile and as provided for in 780 CMR 1820.2 and 1820.6, reinforcement, where required, shall be assembled and tied together and shall be placed in the pile as a unit before the reinforced portion of the pile is filled with concrete.

1820.1.2.1 Seismic reinforcement: All cast-in-place concrete piles shall have minimum reinforcement of 0.25% of the pile cross-sectional area for buildings assigned to *Seismic Performance Category C*, and a minimum reinforcement of 0.50% for buildings assigned to *Seismic Performance Category D* in accordance with 780 CMR 1612.2.7. The reinforcing shall be placed in the top ⅓ of the pile length or extend ten feet (3 m) from the top of the pile, whichever is the longer length.

For *Seismic Performance Category C* buildings, the pile reinforcing shall be a minimum of four longitudinal bars with closed ties, or equivalent spirals, having a minimum diameter of ¼ inch. The ties shall be provided at a maximum spacing of 16 times the longitudinal reinforcing bar diameter. The maximum tie spacing in the top two feet (610 mm) of the pile length shall be four inches (102 mm). Tie detailing shall be in accordance with 780 CMR 1903.4

For *Seismic Performance Category D* buildings, the pile reinforcing shall be minimum of four longitudinal bars with closed ties, or equivalent spirals, having a minimum diameter of ⅜ inch, for piles with a diameter of 20 inches (205 mm) or less; and a minimum tie diameter of ½ inch, for piles with a diameter more than 20 inches (508 mm). The ties shall be provided at a minimum spacing of eight times the longitudinal reinforcing bar diameter. The maximum tie spacing in the top four feet (1.2 m) of the pile length shall be three inches (76 mm)

Exception: Pile ties or spirals are not required where permanent metal casing (steel pipe, steel tube or spiral-welded steel shell) is used, provided the casing has minimum thickness as follows: for *Seismic Performance Category C* buildings, 0.058 inch (1.5 mm), and for *Seismic Performance Category D* buildings, 0.070 inch (1.8mm). The steel casing must be adequately protected from corrosion due to soil, changing water levels or other subgrade conditions indicated by the site soil investigation.

1820.1.2.2 Pile cap seismic connection: All cast-in-place concrete piles shall be connected to the pile cap by extending the pile reinforcing into the pile cap for a distance equal to the development length as specified in ACI 318 listed in Appendix A. The development length to be provided in the cap is the full development length for compression without reduction in length for excess area. Field-placed dowels anchored at least twice the required cap development length are acceptable.

1820.1.3 Installation: For all cased piles, the inside of the pipe or casing shall be thoroughly cleaned to the bottom and visually inspected prior to filling with concrete. The piles shall be poured in such a manner as to exclude all foreign matter and to assure a well-formed unit of full cross-section. The concreting shall be subject to the following limitations.

1. The diameter shall not vary more than 20% from the specified value.
2. Concrete shall not be placed through water except where tremie methods are approved.
3. When depositing concrete from the top of the pile, the concrete flow shall be rapid and continuous, and centered at the top of the pile.

4. After filling with concrete, the top ten feet (3 m) shall be thoroughly rodded.
5. No pile shall be installed within a distance of nine feet (2.7 m) from a pile which has been filled with concrete for less than 12 hours, unless approved.

1820.2 Augered uncased piles:

1820.2.1 Definition: An augered uncased pile is defined as a structural member installed utilizing a hollow-stem auger no less than 12 inches (305 mm) in outside diameter which extends to satisfactory bearing materials to develop support by end bearing and/or friction in those materials.

1820.2.2 Pile diameter: The design pile diameter shall be taken as the outside diameter of the hollow stem auger.

1820.2.3 Allowable design stresses: Except as provided in 780 CMR 1817.5, the design stresses shall not exceed the following values:

1. For compression loads: The maximum allowable design stress on the cement grout or concrete shall be 33% of the specified 28- day unconfined compressive strength, but not exceeding 1,600 psi. The maximum allowable design stress on the steel reinforcing, including permanent steel casing, shall be 40% of the minimum specified yield strength, but not exceeding 24,000 psi.
2. For tension loads: The maximum allowable design tensile stress on the steel reinforcing shall be 60% of the minimum specified yield strength. The allowable design tensile stress on the cement grout shall be zero.

1820.2.4 Reinforcement: Reinforcement shall be as required in 780 CMR 1820.1., except reinforcement may be placed after withdrawal of the auger where approved by the code official.

1820.2.4.1 Concrete cover: The minimum concrete cover shall be 2½ inches (64 mm) for uncased shafts and one inch (25 mm) for cased shafts.

1820.2.4.2 Corrosion protection: Corrosion protection shall be as detailed in 780 CMR 1820.6.6.

1820.2.5 Minimum spacing: The minimum center-to-center spacing between adjacent piles shall not be less than 30 inches (760 mm) or two times the pile diameter, whichever is greater. In addition, for groups of friction piles, the overall circumference of a pile group shall exceed the sum of the circumferences of all of the individual piles within the group.

1820.2.6 Installation: Augered uncased piles shall be formed by advancing a closed-end continuous-flight hollow-stem auger of uniform diameter through unsuitable material and into a satisfactory bearing material followed by removal of the tip closure and pumping cement grout or concrete through the hollow-stem while the hollow-stem auger is extracted. During advancement, the hollow-stem auger shall be rotated rapidly such that the material through which the auger is being advanced is removed by the auger flights and is not displaced laterally by the auger. During withdrawal, if the hollow stem auger is rotated, it shall be rotated in a positive (advancing) direction.

1. The grout or concrete shall be pumped under continuous pressure and in one continuous operation. Grout or concrete pump pressures shall be measured and maintained at all times sufficiently high to offset hydrostatic and lateral earth pressures. The rate of withdrawal of the auger shall be carefully controlled to exclude all foreign matter and ensure that the augered hole is completely filled with grout or concrete as the auger is withdrawn. The actual volume of grout or concrete pumped into each hole shall be equal to, or greater than , the theoretical volume of the augered hole.
2. If the grouting or concreting process of any pile is interrupted, or a loss of concreting pressure occurs, the pile shall be redrilled to its original depth plus six inches (152 mm) (unless bearing on rock) and filled from the bottom.
3.. Augered uncased piles shall not be installed within six pile diameters (center-to-center) of a pile filled with grout or concrete less than 24-hours old except where approved by the code official.

1820.2.7 Records: The owner shall engage a *registered design professional* to monitor the installation of augered uncased piles in accordance with 780 CMR 1816.13. The design professional or his representative shall make an accurate record of the installation equipment used, pile dimensions, grout or concrete volumes, reinforcement, interruptions or delays in pile installation, and all other pertinent installation data.

1820.2.8 Instrumentation: The continuous-flight auger rig utilized to install augered uncased piles shall be equipped with data logging equipment that automatically monitors and produces a real-time printout of depth, grout or concrete pressure, grout or concrete flow, and rate of auger withdrawal. The automatic monitoring equipment shall immediately indicate to the equipment operator, and record on the printed record, any instance during the withdrawal of the hollow-stem auger where the rate of auger withdrawal times the theoretical pile cross-sectional area exceeds the rate of grout or concrete placement. A printed instrumentation readout for each pile shall be provided to the compression load on the reinforcing steel. If a steel pipe section is used for reinforcing, any portion of the cement grout enclosed within the pipe may also be included at the allowable stress for the grout.

1820.6.3.2 Load test: For all design loads, the allowable load shall be determined by load tests in accordance with 780 CMR 1817.4. Load tests may be waived by the code official based on substantiating data and analyses prepared by a *registered design professional*.

1820.6.3.3 Alternative load test procedure for friction piles: For piles designed as friction piles, the friction capacity in compression may be verified by load testing in tension. The tension load test shall be performed in accordance with 780 CMR 1817.7, with the following exceptions:

1. The test pile must be cased or left ungrouted down to the top of the bearing stratum in a manner which will ensure that no friction resistance is developed above the bearing stratum.
2. The maximum design load shall be taken as 50% of the applied test load which results in a movement under load of ½ inch (13 mm) at the pile tip. The movement at the pile tip shall be a.) measured directly by a tell-tale or b.) computed by deducting the theoretical elastic elongation of the pile from the displacement measured at the top of the pile.

1820.6.4 Installation: The pile may be formed in a hole advanced by rotary or rotary percussive drilling methods (with or without temporary casing), by a hollow-stem auger, or by driving a temporary casing. The pile shall be grouted with a fluid cement grout. The grout shall be pumped through a tremie pipe extending to the bottom of the pile until grout of suitable quality returns at the top of the pile.

The following requirements apply to specific installation methods:

1. Piles grouted with temporary casing: For piles grouted inside a temporary casing, the reinforcing steel shall be inserted prior to withdrawal of the casing. The casing shall be withdrawn in a controlled manner with the grout level maintained at the top of the pile, to ensure that the grout completely fills the drill hole. During withdrawal of the casing, the grout level inside the casing shall be monitored to check that the flow of grout inside the casing is not obstructed.
2. Piles grouted without temporary casing: For a pile or portion of a pile grouted in an open drill hole in soil without temporary casing, the minimum design diameter of the drill hole shall be verified by a suitable device immediately prior to grouting. The reinforcing steel shall be inserted prior to grouting.
3. Piles grouted with hollow-stem augers: For piles installed with a hollow-stem auger, the grout shall be pumped under continuous pressure, and the rate of withdrawal of the auger shall be carefully controlled to ensure that the hole is completely filled with grout as the auger is withdrawn. The actual volume of grout pumped for each one foot (0.3 m) of withdrawal of the auger shall be recorded and must be equal to or greater than the theoretical volume. The reinforcing steel shall be inserted prior to withdrawal of the auger.
4. For piles designed for end bearing, a suitable means shall be employed to verify that the bearing surface is properly cleaned prior to grouting.
5. Subsequent piles shall not be drilled or driven near piles that have been grouted until the grout has had sufficient time to harden.

1820.6.5 Pile diameter: The design pile diameter shall be taken as:

1. The outside diameter of the temporary casing; or
2. The diameter of a full circumferential drill bit attached to the bottom of the temporary casing; or
3. The outside diameter of the hollow-stem auger; or
4. The borehole diameter verified by suitable measurements made immediately prior to grouting.

1820.6.6 Corrosion protection:

1. Minimum grout cover: Where steel reinforcing is not enclosed inside a permanent casing, centralizers shall be provided on the reinforcing to ensure a minimum grout cover of one inch (25 mm) in soil and ½ inch (13 mm) in rock. Grout cover requirements may be reduced when the reinforcing steel is provided with a suitable protective coating.
2. Permanent steel casing that is used as structural reinforcing shall be protected in accordance with the provisions of 780 CMR 1816.4.2.
3. For piles subjected to sustained tension loading in corrosive environments, the reinforcing steel shall be protected by a suitable protective coating or encapsulation method.

1820.6.7 Records: The owner shall engage a *registered design professional* to observe the installation of the piles in accordance with 780 CMR 1816.13. The design professional or his representative shall make an accurate record of the installation equipment used, pile dimensions, grouting volumes and procedures used and all other pertinent installation data.

780 CMR 1821.0 PRECAST CONCRETE PILES

1821.1 Design and manufacture: All piles shall be designed and manufactured in accordance with accepted engineering practice to resist all stresses induced by handling, driving and service loads. The minimum lateral dimension shall be ten inches (254 mm). All corners of square piles shall be chamfered. Longitudinal steel shall be arranged in a symmetrical pattern and shall be laterally tied with steel ties or wire spiral spaced not more than three inches (76 mm) apart, center to center, for a distance of two feet (610 mm) from the ends of the pile; and not more than six inches (152 mm) elsewhere except that at the ends of each pile, the first five ties or spirals shall be spaced one inch (25 mm) center to center. When driven to or into bearing materials of Classes 1 to 6 inclusive, or through materials containing boulders, piles shall have metal tips of approved design.

1821.1.1 Installation: All piles shall be handled and driven so as not to cause injury or overstressing which affects durability or strength.

1821.2 Reinforced piles: Reinforced precast concrete piles shall conform to 780 CMR 1821.2.1 through 1821.2.5.

1821.2.1 Design: The minimum amount of longitudinal reinforcement shall be 2% of the concrete section and shall consist of at least four bars.

1821.2.2 Material: All concrete shall have a 28-day specified compressive strength (f'_c) of not less than 4,000 psi (2.81 kg/mm^2).

1821.2.3 Allowable stress: The allowable compressive stress in the concrete shall not exceed 33% of the 28-day specified compressive strength (f'_c) nor 1,600 psi applied to the gross cross-sectional area of the pile.

1821.2.4 Concrete cover: All pile reinforcement shall have a concrete cover of not less than two inches (51 mm), except that piles exposed to sea water shall have a minimum protective concrete cover of three inches (76 mm).

1821.2.5 Installation: A precast concrete pile shall not be driven before the concrete has attained a compressive strength of at least 3,000 psi (2.11 kg/mm^2), but not less than such strength sufficient to withstand handling and driving forces.

1821.2.6 Pile cap seismic connection: Precast concrete piles shall be connected to the pile cap in accordance with the requirements of 780 CMR 1820.1.2.2.

1821.3 Prestressed piles: Prestressed concrete piles shall conform to the requirements of 780 CMR 1821.3.1 through 1821.3.6.

1821.3.1 Design: The effective prestress in the pile shall not be less than 700 psi (0.49 kg/mm^2).

1821.3.2 Material: Prestressing steel shall conform to ASTM A416 listed in *Appendix A*. All concrete shall have a 28-day specified compressive strength (f'_c) of not less than 5,000 psi (3.52 kg/mm^2).

1821.3.3 Allowable stress: The maximum allowable design compressive stress (f_c) in concrete shall be determined as follows:

$$f_c = 0.33\, f'_c - 0.27\, f_{pc}$$

where f'_c is the 28-day compressive strength and f_{pc} is the effective prestress on the gross area of the pile section; however, 0.33 f'_c shall not exceed 1,600 psi.

1821.3.4 Installation: A prestressed pile shall not be driven before the concrete has attained a compressive strength of at least 4,000 psi (2.81 kg/mm2), but not less than such strength sufficient to withstand handling and driving forces.

1821.3.5 Pile cap seismic connection: Prestressed concrete piles shall be connected to the pile cap in accordance with the requirements of 780 CMR 1820.1.2.2 or by extension of the pile reinforcing strand into the pile cap. The embedment of reinforcing into the pile cap shall develop the strength of the reinforcing strand. Prestressed pile cap connections in buildings assigned to *Seismic Performance Category D*, in accordance with 780 CMR 1612.2.7, shall not be by development of exposed strand.

1821.3.6 Spiral seismic reinforcing: The upper two feet of the pile immediately below the pile cap shall have No. 3 ties minimum at not over four-inch spacing, or equivalent spirals. The spiral reinforcement in prestressed piles for buildings assigned to *Seismic Performance Category D*, in accordance with 780 CMR 1612.2.7, shall not be less than 0.6% for the full length of the pile where subjected to vertical *loads* only or where the design bending moment does not exceed 20% of the unfactored ultimate moment capacity at balanced strain conditions computed in accordance with ACI 318 listed in *Appendix A*.

780 CMR 1822.0 TIMBER PILES

1822.1 Materials: Round timber piles shall conform to ASTM D25 listed in *Appendix A*. Round timber piling shall be new longleaf, shortleaf, loblolly or slash species of Southern pine, oak, Douglas fir or other woods of similar strength and physical characteristics.

1822.2 Preservative treatment: Timber piles used to support permanent structures shall be pressure treated in accordance with AWPA C3 listed in *Appendix A* for round timber piles. Preservative-treated timber piles shall be subject to a quality control program administered by an approved agency. Pile cutoffs shall be treated in accordance with AWPA M4 listed in *Appendix A*.

1822.3 Allowable load:

1822.3.1 Allowable stress: The allowable stress in the timber shall not exceed 1,000 psi in compression at the critical cross-sectional area taken at the top of the bearing stratum. Piles designed for end bearing on materials of Classes 1 through 5 shall be designed for a maximum stress of 500 psi in compression on the pile cross-sectional area at the tip.

1822.3.2 Maximum Load: The load on timber piles shall not exceed the allowable load specified in 780 CMR 1817.0 nor 35 tons, whichever is smaller.

1822.3.3 Minimum dimensions: Timber piles shall be sized to conform to the minimum tip sizes as specified in ASTM D25 but no less than six inches (152 mm) in diameter at the tip.

1822.4 Precautions during driving:

1822.4.1 Hammer energy: Pile hammer energy shall be selected to prevent damage to the pile, but in no case shall the maximum hammer energy, as rated by the manufacturer, exceed 18,000 ft. lbs. For end bearing piles, on materials of Class 1 through 5, the maximum hammer energy shall be reduced.

1822.4.2 Driving resistance: Driving shall be stopped immediately when abrupt high resistance to penetration is encountered. Any sudden decrease in driving resistance of an end-supported timber pile shall be investigated with regard to the possibility of damage. If the sudden decrease in driving resistance cannot be correlated to loadbearing data, the pile shall be removed for inspection or rejected.

780 CMR 1823.0 COMPOSITE PILES

1823.1 Design: Composite piles consisting of two or more approved pile types shall be designed to meet the conditions of installation.

1823.2 Limitation of load: The maximum allowable load shall be limited by the capacity of the weakest section incorporated in the pile.

1823.3 Splices: Splices between concrete and steel or wood sections shall be designed to prevent separation both before and after the concrete portion has set, and to insure the alignment and transmission of the total pile load. Splices shall be designed to resist uplift caused by upheaval during driving of adjacent piles, and shall develop the full compressive strength and not less than 50% of the tension and bending strength of the weaker section.

780 CMR 1824.0 CONCRETE-FILLED PIPE WITH STEEL CORE CAISSONS

1824.1 Construction: These units shall consist of a shaft section of concrete-filled pipe extended to and firmly seated in bedrock of Classes 1 or 2 with an uncased socket drilled into the bedrock which is filled with cement grout. A steel core shall be centered in the shaft and shall extend through the cement grout to the bottom of the socket.

1824.2 Rock socket: A socket, approximately the inside diameter of the pipe, shall be made in bedrock of Classes 1 or 2 to a depth that will assure load transfer when computed for bearing on the bottom surface of the socket in accordance with 780 CMR 1803.0, 1807.0 and 1817.0 acting together with a bond stress on the perimeter surface of the socket. The socket design stress shall be determined by a *registered design professsional* based upon foundation investigation study in accordance with 780 CMR 1816, but in no case will the design bond stress on the perimeter of the socket exceed 200 psi. Load tests, in accordance with 780 CMR 1817.4, may be required by the code official if foundation investigation data are judged insufficient to verify the selected bond stress. The minimum socket depth shall be at least equal to the diameter of the pipe. Before placement of concrete, the socket and pipe shall be thoroughly cleaned and the rock inspected by a *registered design professional* or his qualified representative.

1824.3 Seismic design: All caisson piles shall meet the seismic design requirements of 780 CMR 1819.3.

1824.4 Material: Pipe and steel cores shall conform to the material requirements in 780 CMR 1818.0. Pipe shall have a minimum diameter of 18inches (457 mm) and a minimum wall thickness of ⅜ inch (9.5 mm) and shall be fitted with a suitable steel driving shoe welded to the bottom of the pipe. All concrete shall have a 28-day specified compressive strength (f'_c) of not less than 4,000 psi (2.81 kg/mm^2). The concrete mix shall be designed and proportioned so as to produce a cohesive workable mix with a slump of four inches (102 mm) to six inches (152 mm).

1824.5 Structural core: The gross cross-sectional area of the structural steel core shall not exceed 25% of the gross area of the caisson. The minimum clearance between the structural core and the pipe shall be two inches (51 mm). If cores are to be spliced, the ends shall be milled or ground to provide full contact and shall be full-depth welded.

1824.6 Allowable stress: The allowable design compressive stresses shall not exceed the following: concrete, 0.33 f'_c; steel pipe, 0.35 f_y; and structural steel core, 0.50 f_y.

1824.7 Installation: The rock socket and pile shall be thoroughly cleaned of all foreign materials before filling with cement grout and concrete. Steel cores shall be bedded in cement grout at the base of the rock socket.

1824.8 Spacing: The minimum center-to-center spacing shall be not less than 2½ times the outside diameter of the steel shell.

780 CMR 1825.0 RETAINING WALLS

1825.1 General: Walls built to retain or support the lateral pressure of earth or water or other superimposed loads shall be designed and constructed of approved masonry, reinforced concrete, steel sheet piling or other approved materials within the allowable stresses specified in 780 CMR 2311.7.

1825.2 Design: Retaining walls shall be designed to resist the pressure of the retained material, including both *dead* and *live load* surcharges to which such walls are subjected, and to insure stability against overturning, sliding, excessive foundation pressure and water uplift. Retaining walls shall be designed to resist seismic loads in accordance with 780 CMR 1612.4.9.

1825.3 Hydrostatic pressure: Unless drainage is provided, the hydrostatic head of the water pressure shall be assumed to be equal to the height of the wall.

1825.4 Coping: All masonry retaining walls, other than reinforced concrete walls, shall be protected with an approved coping.

1825.5 Guards: Where retaining walls with differences in grade level on either side of the wall in excess of four feet (1.2 m) are located closer than two feet (0.6 m) to a walk, path, parking lot or driveway on the high side, such retaining walls shall be provided with guards that are constructed in accordance with 780 CMR 1021.0 or other approved protective measures.

CHAPTER 28

MECHANICAL SYSTEMS

780 CMR 2801.0

2801.1 Scope: The provisions of 780 CMR 28 shall control the construction, inspection and maintenance of all mechanical equipment and systems with respect to structural strength, fire safety and operation.

Note: Also see 780 CMR 9, 12 and 13.

2801.2 Mechanical code: All mechanical equipment and systems shall be constructed, installed and maintained in accordance with the BOCA National Mechanical Code listed in ***Appendix A***.

2801.2.1 Heating, Pumping, Process Piping and Refrigeration Systems: Heating, pumping, process piping and refrigeration systems shall be installed by contractors and personnel appropriately licensed in the Commonwealth of Massachusetts (Installing Contractor). Engineered designs and specifications prepared by Registered Professional Engineers shall identify systems requiring compliance with appropriate sections of M.G.L. c. 146 and 528 CMR. Shop drawings and design layout prepared by licensed installing contractors shall note the name(s), license number(s) and license expiration date(s) of the contractor(s) installing the heating, pumping, process piping and refrigeration systems. (See Installing Contractor Definition 780 CMR 202.0).

2801.2.2 Location of Air Intakes and Outlets:

2801.2.2.1 Location of Outdoor Air Intakes: Outdoor air intakes shall be located such that the distance measured from the closest point of the intake opening to the object, or point, listed in Table 2801.2.2.1 exceeds the minimum separation distance listed in Table 2801.2.2.1.

Exception: Shorter separation distances are acceptable if it can be shown that an equivalent rate of introduction of outdoor air contaminants will be attained using an alternative design, and if approved by the authority having jurisdiction.

Table 2801.2.2.1
AIR INTAKE MINIMUM SEPARATION DISTANCE

Object	Minimum Distance, ft
Property line	3
Garage entry, loading area, or drive-in queue (Note 1)	25
Driveway or street	10
Limited access highway	25
Mantles or ledges (Note 2)	3
Landscaped grade (Note 3, 4)	6
Roof or grade (Note 4)	0.75
Cooling towers (Note 5)	15

Note 1: These areas are likely locations where vehicles will be paused and idling, such as while paying parking fees or waiting for traffic in the case of the garage entry, while loading or unloading materials in case of the loading area, or waiting in line for drive-in restaurant or bank service in the case of the drive-in queue.

Larger separation distances may be needed if the intake is located directly above the likely location of idling vehicles.

Note 2: Applies to mantles or ledges that are sloped less than 45 degrees from the horizontal and that are more than six in. wide.

Note 3: Landscaped grade is soil, lawn, shrubs, or any plant life within 1.5 ft horizontally of intake.

Note 4: Intake must be at least eight in. above the average maximum snow depth at the intake.

Note 5: Applies to closest wetted surface of tower, such as intake or basin. See Section 5.5 for separation distance from tower discharge.

2801.2.2.2 Exhaust outlets and air intakes: Exhaust air and vent outlets shall be located no closer to outdoor air intakes than the minimum separation distance determined in accordance with Equation 2801.2.2.2:

Equation 2801.2.2.2

$$S = 0.04 \times Q^{0.5} (D^{0.5} - V/2)$$

Where:

Q = Exhaust air volume, cfm. The value used in Equation 2801.2.2.2 shall not be less than 150 cfm nor exceed 3000 cfm regardless of actual volume. For gravity vents such as plumbing vents, use an exhaust rate of 150 cfm. For flue vents from fuel burning appliances, assume a value of 250 cfm per million Btu/hr of combustion input (or obtain actual rates from the combustion appliance manufacturer).

D = Dilution factor:

1. Dilution factor shall be five for exhaust air outlets from spaces without unusual sources of contaminants.
2. Dilution factor shall be ten for exhaust air outlets with mild contaminants including copy rooms, printer rooms, dining area and break rooms, cafeterias, laundry rooms, locker rooms and residential kitchens and bathrooms.
3. Dilution factor shall be 15 for plumbing vents and exhaust air outlets from spaces with significant contaminant intensity including public toilets or toilets in health care facilities, commercial kitchens, laboratories, dry-cleaning establishments and indoor swimming pools.
4. Dilution factor shall be 25 for air with noxious or toxic fumes or gases including spray paint booths, garages, tunnels, kitchen grease

hoods, laboratory fume hoods, chemical storage, refrigerating machinery rooms, soiled laundry storage and natural gas and propane burning appliance vents.

5. Dilution factor shall be 50 for air with a high concentration of dangerous particles including vents from fuel burning appliances other than natural gas or propane burning appliances, uncleaned fume hood exhaust, evaporative condenser and cooling tower outlets.

V = Exhaust air discharge velocity, fpm . V shall have a positive value when the exhaust is directed away from the object, and shall have a negative value when the exhaust is directed towards the object. V shall be set to 0 in Equation 2801.2.2.2 for vents from gravity (atmospheric) fuel fired appliances, plumbing vents, and other non-powered exhausts, or if the exhaust discharge is covered by a cap or other device that dissipates the exhaust air stream. For hot gas exhausts such as combustion products, an effective additional 500 fpm upward velocity shall be added to the actual discharge velocity.

2801.2.2.3 Exhaust outlets and windows: Exhaust air and vent outlets shall be located no closer to operable windows than one-half the minimum separation distance determined in accordance with Equation 2801.2.2.2.

For exhaust air with a dilution factor greater than ten the horizontal distance between outlets and operable windows shall be at least the minimum separation distance determined in accordance with Equation 2801.2.2.2.

2801.2.2.4 Exhaust outlets and property lines: Exhaust air outlets shall be located at least ten feet from property lines for air with a dilution factor greater than ten, in accordance with Equation 2801.2.2.2.

Exception: exhausts located ten ft. or more above grade where the property line abuts a street or public way.

780 CMR 2802.0 CONSTRUCTION DOCUMENTS

2802.1 General: The *construction documents* for the installation, repair, extension or removal of any mechanical equipment or system shall be submitted in accordance with 780 CMR 110.0 and a building permit shall be secured prior to the commencement of any work.

2802.2 Matter covered: The *construction documents* shall show in sufficient detail all applicable features and clearances of the appliances and systems, including: size and type of apparatus; construction of flue, stack or chimney; stack connections; type of fuel; method of operation; and the method of compliance with all regulations for the class and type of equipment installed.

2802.3 Details: An application for a building permit for mechanical systems shall be accompanied by *construction documents* complying with the provisions of the mechanical code listed in *Appendix A* before a permit shall be issued for the mechanical equipment or system. The *construction documents* shall be drawn to a scale of not less than ⅛ inch to the foot (1:100). and shall show the location and arrangement of all equipment and distribution elements including safeties and pressure-controlling devices.

Note: Also see 780 CMR 2803.1.

780 CMR 2803.0 FEES

2803.1 General: Fees for mechanical work, shall be included in the building permit application (see 780 CMR 114.0).

780 CMR 2804.0 INSPECTIONS AND TESTS

2804.1 Inspection: All mechanical equipment and systems requiring a permit shall be inspected in accordance with the BOCA National Mechanical Code listed in *Appendix A* and shall not be placed in operation until having been tested and approved.

2804.2 Concealment: It shall be unlawful for owners, contractors or workers to lath over or in any way conceal any piping, outlet boxes or other parts of the mechanical equipment or system requiring a permit until an inspection has been made thereof and due notice has been given that the work has been approved.

2804.3 Defects and repairs: Upon inspection or reinspection of a mechanical system, any defects or deficiencies which require repair to insure safe operation shall be rectified before the system is placed in service.

2804.4 Power to deem unsafe: A system or any part thereof that is found to be unsafe to life or property, shall be deemed unsafe and shall not be restored to service until such system has been made safe and approved.

780 CMR 2805.0 PLENUMS

2805.1 General: The term "plenum" shall mean an enclosed portion of the building structure which forms part of an air distribution system and is designed to allow the movement of air. Supply, return, exhaust, relief and *ventilation* air plenums shall be limited to uninhabited crawl spaces, areas above a ceiling or below the floor, or *attic* spaces and mechanical equipment rooms. The location of supply and return air plenums shall also comply with 780 CMR 1005.7. Plenums shall be limited to one *fire area*. Fuel-fired equipment shall not be installed within a plenum. In buildings of Type I or 2 construction, all plenums shall be noncombustible and shall comply with 780 CMR 2805.2. In buildings of Type 3, 4 or 5 construction, noncombustible plenums in accordance with 780 CMR 2805.2, combustible plenums in accordance with 780 CMR 2805.3, and stud and joist space plenums in accordance with 780 CMR 2805.4, shall be permitted.

2805.2 Noncombustible plenums: Plenums shall be constructed with noncombustible material. Combustible material shall not be exposed within a plenum except as permitted in 780 CMR 2805.2.1 through 2805.2.6.

2805.2.1 Pipe: Pipe shall be noncombustible except that plastic fire *sprinkler* piping in wet pipe systems shall be permitted where the piping has a peak optical density not greater than 0.50, an average optical density not greater than 0.15 and a flame spread not greater than 5.0 feet (1524 mm) when tested in accordance with UL 1887 listed in *Appendix A*. Piping shall bear the *label* of an *approved agency*.

2805.2.2 Ceiling and thermal material: Thermal and acoustical materials and pipe insulation shall have a flame spread of 25 or less and a smoke-developed rating of 50 or less when tested in accordance with ASTM E84 listed in *Appendix A*.

2805.2.3 Ducts: Rigid or flexible ducts and connectors shall conform to the mechanical code listed in *Appendix A*.

2805.2.4 Duct coverings: Duct coverings, linings, tape and connectors shall conform to the BOCA National Mechanical Code listed in *Appendix A*.

2805.2.5 Wire: Wire shall be low-voltage or power-limited wire or cable. Wire shall have a peak optical density not greater than 0.50, an average optical density not greater than 0.15 and a flame spread of not greater than five feet (1524 mm) when tested in accordance with UL 910 listed in *Appendix A*. Wire shall bear the *label* of an *approved agency* and shall be marked in accordance with 527 CMR 12.00 listed in *Appendix A*.

2805.2.6 Combustible pneumatic tubing: Combustible pneumatic tubing shall have a peak optical density not greater than 0.50, an average optical density not greater than 0.15 and a flame spread of not greater than five feet (1524 mm) when tested in accordance with UL 1820 listed in *Appendix A,* and shall bear the *label* of an *approved agency*.

2805.3 Combustible plenums: The plenum shall be constructed with approved material. Combustible material, pipe or wire exposed within the plenum shall be permitted.

2805.3.1 Size: Combustible plenums shall be *draftstopped* every 3,000 square feet (279 m2) in area.

Exception: Plenums shall be limited to one *fire area* without *draftstopping* in buildings equipped throughout with an *automatic sprinkler* system in accordance with 780 CMR 906.2.1.

2805.4 Stud and joist spaces: The space between studs or joists shall not be utilized as a plenum for supply air. The space between studs or joists utilized as a plenum for return air shall not be part of a required fireresistance rated assembly. Air shall be removed from one floor level only. All connections shall be *firestopped* and *draftstopped*.

780 CMR 2806.0 DRYING ROOMS

2806.1 General: A drying room or dry kiln installed within a building shall be constructed entirely of approved noncombustible materials or assemblies of such materials with the required fireresistance rating based on the fire hazard of the contents and the process, as required in 780 CMR 4.

2806.2 Piping clearance: All overhead heating pipes shall have a clearance of not less than two inches (51 mm) from combustible contents of the dryer.

2806.3 Insulation: Where the operating temperature of the dryer is 175°F (79°C) or more, metal enclosures shall be insulated from adjacent combustible materials by not less than 12 inches (305 mm) of air space, or the metal walls shall be lined with ¼-inch insulating mill board or other approved equivalent insulation.

2806.4 Fire protection: Drying rooms designed for high-hazard materials and processes, including special occupancies as provided for in 780 CMR 4, shall be protected by an approved *automatic fire suppression system* conforming to the provisions of 780 CMR 9.

780 CMR 2807.0 WASTE- AND LINEN-HANDLING SYSTEMS

2807.1 General: Waste (refuse) and linen (laundry) systems shall be installed in accordance with 780 CMR 2807.0 and the provisions of Chapters 3 and 4 of NFiPA 82 listed in *Appendix A*.

Exception: Systems serving and contained within a single *dwelling unit*.

2807.2 Waste and linen chute enclosures: A *shaft* containing a refuse or linen chute shall not be used for any other purpose and shall be enclosed in accordance with 780 CMR 710.0. All openings into the *shaft*, including those from access rooms and termination rooms, shall be protected with approved

NON-TEXT PAGE

CHAPTER 34

REPAIR, ALTERATION, ADDITION, AND CHANGE OF USE OF EXISTING BUILDINGS

(780 CMR 34 is entirely unique to Massachusetts)

780 CMR 3400.0 SCOPE

3400.1 General: The provisions of 780 CMR 34 are intended to maintain or increase public safety, health, and general welfare in existing buildings by permitting repair, alteration, addition, and/or change of use without requiring full compliance with the code for new construction except where otherwise specified in 780 CMR 34.

3400.2 Compliance: Repairs, alterations, additions, and changes of use shall conform to the requirements of 780 CMR 34. Where compliance with the provisions of this code for new construction is required by 780 CMR 34, and where such compliance is impractical because of construction difficulties or regulatory conflicts, *compliance alternatives* as described in 780 CMR 3406.0 may be accepted by the *building official*.

> **Note**: Specialized codes, rules, regulations, and laws pertaining to repair, alteration, addition, or change of use of existing buildings promulgated by various authorized agencies may impact upon the provisions of 780 CMR 34. Specialized state codes, rules, regulations, and laws include, but are not limited to those listed in ***Appendix A.***

3400.3 Applicability: The provisions of 780 CMR 34 apply to repair, alteration addition or change in use to existing buildings which qualify to use 780 CMR 34 (see 780 CMR 3400.3.1), based on the proposed continuation of, or change in use group, as follows:

1. Continuation of the same *use group*, or a change in *use group* which results in a change in *hazard index* of one or less as determined by 780 CMR 3403 shall comply with 780 CMR 3404.0.
2. Change in use group to a use group with *hazard index* of two or more greater than the *hazard index* of the existing use shall comply with the requirements of 780 CMR 3405.0 and the code for new construction.
3. **Part change in use (Mixed Use)**: Portions of the building is changed to a new *use group*, shall be separated from the remainder of the building with *fire separation assemblies* complying with 780 CMR 313, or with approved *compliance alternatives*. The portion of the building changed shall be made to conform with the applicable provisions of 780 CMR 34.
4. **Additions**: Additions to *existing buildings* shall comply with all code requirements for new construction, except as otherwise provided in 780 CMR 34. The combined height and area of the *existing building* and the addition shall not exceed that allowed by 780 CMR 503.0 and Table 503 as modified by 780 CMR 504 and 506. Where a *fire wall* complying with 780 CMR 707.0 and 708.0 is provided, the addition shall be considered as a separate building.
5. ***Ordinary repairs***: *Ordinary repairs* conforming to 780 CMR 110.3 (4), 780 CMR 2 and 780 CMR 902 may be performed without a building permit.
6. **Assembly use groups**: A change from any other use group to an assembly use group (A) or any alteration or change in occupancy within an assembly use group shall comply with the requirements of the code for new construction, except that earthquake requirements need only conform to 780 CMR 3408.
7. **Institutional use groups**: A change from any other use group to an institutional use group (I) or any alteration or change in occupancy within an institutional use group shall comply with the requirements of the code for new construction, except that earthquake requirements need only conform to 780 CMR 3408.
8. **Residential use groups**: A change from any other use group to a residential use group (R) or any alteration or change in occupancy within an residential use group shall comply with the requirements of the code for new construction, except that earthquake requirements need only conform to 780 CMR 3408.
9. ***Historic buildings***: Buildings which qualify as *totally or partially preserved historic buildings* in accordance with 780 CMR 3409 shall meet the provisions of 780 CMR 3409.
10. **Structural requirements**: Structural requirements for additions, and for *existing buildings* subject to repair, alteration, and/or change of use, shall be in accordance with 780 CMR 3408.

> **Exceptions**: *Totally Preserved and Partially Preserved Historic Buildings*

3400.3.1 Buildings which qualify: The provisions of 780 CMR 34 shall apply to *existing buildings* which have been legally occupied and/or used for a period of at least five years. Any building for which there exists an outstanding notice of violation or other order of the building official shall not qualify to use 780 CMR 34 unless such proposed work includes the abatement of all outstanding violations and compliance with all outstanding orders of the building official. Buildings which do not qualify as *existing buildings* for the purposes of 780 CMR 34 shall comply fully with the applicable provisions of this code for new construction.

Exceptions:

(1) *Existing buildings* or portions thereof which are changed in use from any other use group to day care centers (I-2 or E) shall not qualify as *existing buildings* for the purposes of 780 CMR 34, but shall comply with the requirements of 780 CMR 4, as applicable.

(2) *Existing buildings* or portions thereof, which are changed in use from any use to a Group Residence, Limited Group Residence or Group Dwelling Unit shall not qualify as *existing buildings* for the purposes of 780 CMR 34, but shall comply with the provisions of 780 CMR 4, as applicable.

3400.4 Special Provisions for Means of Egress:

3400.4.1 Existing Non Conforming Means of Egress: The following conditions, when observed by the *building official*, shall be cited, in writing as a violation. Said citation shall order the abatement of the non conformance and shall include such a time element as the building official deems necessary for the protection of the occupants thereof, or as otherwise provided for by statute.

1. Less than the number of *means of egress* serving every space and/or story, required by 780 CMR 1010.0 and Table 1010.2, or 780 CMR 36 for one and two family dwellings.
2. Any required *means of egress* component which is not of sufficient width to comply with 780 CMR 1009, or is not so arranged as to provide safe and adequate *means of egress*, including exit signage and emergency lighting.

3400.5 *Hazardous Means of Egress*:

3400.5.1 Exit Order/Hazardous ***Means of Egress***: In any *existing building* or structure not provided with exit facilities as herein prescribed for new buildings and in which the exits are deemed hazardous or dangerous to life and limb, the *building official* shall declare such building dangerous and unsafe in accordance with the provisions of 780 CMR 121.0.

3400.5.2 Appeal from exit order: Any person served with any order pursuant to 780 CMR 3400.5 shall have the remedy prescribed in 780 CMR 121.

3400.6 Unsafe Lighting and/or Unsafe Ventilation: In any *existing building* , or portion thereof, in which (a) the light or ventilation do not meet the applicable provisions of 780 CMR 12.0 and (b) which, in the opinion of the *building official*, are dangerous, or hazardous, to the health and safety of the occupants, the *building official* shall order the abatement of such conditions to render the building or structure occupiable or habitable as applicable for the posted use and occupant load.

In enforcing the provisions of 780 CMR 3400.6 the *building official* may require or accept engineering or other evaluations of the lighting and/or ventilation systems in order to evaluate possible dangerous or hazardous conditions and acceptable solutions.

Where full compliance with 780 CMR for new construction is not practical for structural and/or other technical reasons, the *building official* may accept compliance alternatives, or engineering or other evaluations which adequately address the building or structure livability for the posted use and occupant load.

780 CMR 3401.0 DEFINITIONS

3401.1 General: Definitions shall, for the purposes of 780 CMR 3401.0, have the meaning shown herein:

Building System: Any mechanical, structural, egress, electrical, plumbing, building enclosure and/or fire protection system, or fire resistive construction system, or portion thereof.

Building System Component: A part or portion of a *building system*.

Compliance Alternative: An alternative life-safety construction feature which meets or exceeds the requirements or intent of a specific provision of 780 CMR. The *Building Official* is authorized to approve or disapprove *compliance alternatives*. *Compliance alternatives* are only permitted for *existing buildings*.

Existing building or structure: Any building or structure qualifying under 780 CMR 3400.3.1.

Hazard Index: A numerical value, between 1 and 8, which is assigned to a specific *Use Group* in order to determine which of the provisions of 780 CMR 34 apply to the proposed work on the *existing building*. The *Hazard Index* is a relative scale used only to determine applicable provisions of 780 CMR 34. *Hazard indices* are listed in Table 3403 and *Appendix F*.

Historic buildings: (a) Any building or structure individually listed on the National Register of Historic Places or (b) any building or structure evaluated by MHC to be a contributing building within a National Register or State Register District. (c) any building or structure which has been certified by the Massachusetts Historical Commission to meet eligibility requirements for individual listing on the National Register of

3404.8 Means of egress lighting: *Means of egress* lighting shall be provided in accordance with 780 CMR 1024.0.

3404.9 Height and Area limitations: The height and area requirements of 780 CMR 5 shall apply to *existing buildings* when such *existing buildings* are modified by addition and/or change in use. Modifications to the height and area requirements as provided in 780 CMR 504.0 and 506.0 are permitted.

3404.10 Existing Fire and party walls: No further compliance is required with 780 CMR 707.0. The height above the roof of existing fire, party and exterior walls need not comply with 780 CMR 3404.0

3404.11 Fire Protection Systems: Fire Protection Systems: Design, installation and maintenance of fire protection systems shall be provided in accordance with 780 CMR 3404.3 and 780 CMR 3404.12 as applicable.

3404.12 Fire protection systems are required for the following cases:

1. Additions where required by 780 CMR 9.0 for the specific *use group*.
2. For *existing buildings* and additions to *existing buildings,* where required by 780 CMR 9 or where required by 780 CMR 506 to satisfy height and area requirements.
3. *Existing buildings*, or portions thereof which are *substantially altered* or *substantially renovated*, and where otherwise required by 780 CMR 9.0 for the specific *use group*.

Note: Notwithstanding the provisions of 780 CMR 3404.12, automatic Fire Suppression systems are required in municipalities which have adopted the provisions of MGL c148 § 26G, H or I (See *Official Interpretation* Number 45-96 listed in *Appendix B*).

3404.13 Enclosure of stairways: Open stairways are prohibited except in one- and two-family dwellings or unless otherwise permitted by 780 CMR 10. There shall be no minimum fireresistance rating required for an existing enclosure of a stairway. Partitions or other new construction which is added in order to fully and solidly enclose a stairway shall provide a minimum fireresistance rating of one hour. All doors in the enclosure shall be self-closing and tight-fitting with approved hardware. All doors in those portions of the stairway which are fireresistance rated shall comply to the applicable provisions of 780 CMR 9.

3404.14 Assembly Use Groups: Notwithstanding the provisions of 780 CMR 3404, Assembly Use Groups shall comply with the provisions of 780 CMR 3400.3, item 6.

3404.15 Institutional Use Groups: Notwithstanding the provisions of 780 CMR 3404, Institutional Use Groups shall comply with the provisions of 780 CMR 3400.3, item 7.

3404.16 Residential Use Groups: Notwithstanding the provisions of 780 CMR 3404, Residential Use Groups shall comply with the provisions of 780 CMR 3400.3, item 8.

3404.17 Fire hazard to adjacent buildings: Any proposed change in the use or occupancy of an existing building which has the effect of increasing the fire hazard to adjacent buildings shall comply with the requirements of Table 705.2 for exterior wall fire resistance rating requirements, or with approved *compliance alternatives*.

3404.18 Accessibility for Persons with Disabilities: Accessibility requirements shall be in accordance with 521 CMR as listed in *Appendix A*.

3404.19 Energy Conservation: Energy conservation requirements shall be in accordance with 780 CMR 3407.0.

780 CMR 3405.0 REQUIREMENT FOR CHANGE IN *USE GROUP* TO TWO OR MORE *HAZARD INDICES* GREATER

3405.1 General: When the existing use group is changed to a new use group of two or more hazard indices higher (as provided in Table 3403), the existing building shall conform to the requirements of the code for new construction, except as provided in 780 CMR 3408 or as otherwise allowed in 780 CMR 3407.0.

3405.2 Accessibility for Persons with Disabilities: Accessibility requirements shall be in accordance with 521 CMR as listed in ***Appendix A***.

780 CMR 3406.0 *COMPLIANCE ALTERNATIVES*

3406.1 General: Where compliance with the provisions of the code for new construction, required by 780 CMR 34, is impractical because of construction difficulties or regulatory conflicts, *compliance alternatives* may be accepted by the building official.

Examples of *compliance alternatives* which have been used are provided in *Appendix F*. The building official may accept these *compliance alternatives* or others proposed.

3406.2 Documentation: In accordance with 780 CMR 3402.1.5, the building official shall ensure that the BBRS is provided with information regarding *compliance alternatives* accepted or rejected by the *building official*.

780 CMR 3407.0 ENERGY PROVISIONS FOR *EXISTING BUILDINGS*

Implementation date: Note that commencing January 1, 1999, replacement windows for existing low-rise residential buildings are required to have a maximum thermal transmittance of 0.44 and such windows must be NFRC listed/labeled.

> **Exception 1:** Criteria for NFRC listing/labeling and maximum U-0.44 are not required if the existing window (s) are true divided light (i.e. – single thickness multi-pane sashes with structural muntin bars) and being replaced with "like kind" units. This Exception additionally requires that a storm window be installed over the replacement window. The storm window may be installed internally, externally, or integrated with the primary window.
>
> **Exception 2:** Criteria for NFRC listing/labeling and maximum U-0.44 are not required for basement windows with a unit height up to 24 inches, whether or not the basement is a conditioned space.

3407.1 General: 780 CMR 3407.0 establishes the energy provisions for *existing buildings* governed by 780 CMR 3404.0 or 780 CMR 3405.0.

3407.2 Compliance: Alterations to any building component affecting the energy conservation performance of an existing building shall comply with the applicable requirements of::

(a) 780 CMR, Table 3407 (COMPONENT VALUES FOR ALTERED ELEMENTS) and all applicable subsections of 780 CMR 13.0, or:
(b) 780 CMR 1304.2 for thermal envelope requirements and all other applicable requirements of 780 CMR 13.0, or:
(c) 780 CMR 1304.5 for thermal envelope requirements and all other applicable requirements of 780 CMR 13.0, or:
(d) 780 CMR 1309, or:
(e) 780 CMR Appendix J, as applicable.

3407.3 Exempt buildings: Refer to 780 CMR 1301.4 for thermally exempt buildings and 780 CMR 1308.1 for lighting exemptions.

3407.4 Compliance exceptions

3407.4.1 Fenestration: When alterations to a wall assembly include only altering the fenestration component, the areas of fenestration may be decreased or replaced with an opaque wall element made to comply with the thermal transmittance value of the existing wall.

3407.4.2 ***Ordinary repairs***: *Ordinary repairs* need not comply with the energy provisions.

> Note that in the repair of broken windows, broken doors or broken skylights, like-kind replacement shall be allowed, but the complete replacement of windows, doors or skylights in an *existing building* shall require compliance with the applicable requirements of 780 CMR 3407.2. Any window replacement that includes new jambs or new jamb liners does not qualify as an "ordinary repair," and such replacement is subject to the energy performance criteria of 780 CMR, 3407.2.

3407.4.3 Roofs: Compliance of the roof/ceiling assembly is not required unless the existing roofing material is stripped off the roof deck. However, if a structural analysis by a registered professional engineer shows that the roof will not support the additional live loads imposed by compliance of the roof/ceiling assembly, or, if such analysis shows that addition of the required amount of insulation will cause ponding of water, then compliance of the roof/ceiling assembly is not required.

TABLE 3407
COMPONENT VALUES FOR ALTERED ELEMENTS

WALLS	All wall construction containing heated or mechanically cooled space	U-0.08	6,8
Foundation Walls Including Band	Containing heated or mechanically cooled space Containing unheated space	U-0.08 U-0.17	4
Roof/Ceiling Assembly	Wood plank and beam construction containing heated or mechanically cooled space	U-0.08	1
Roof/Ceiling Assembly	Construction other than wood plank and beam containing heated or mechanically cooled space	0.05	
Windows and Skylights	All construction enclosing heated or mechanically cooled space	For windows, see Note 2. For skylights - no current restriction on "U" value	2, 5 6, 7
Floors	Floor sections over area exposed to outside air or unheated areas Unheated slab on grade Heated slab on grade	U-0.08 R-5.50 R-7.75	3
Mechanical Equipment	Heating, cooling, sizing and efficiency	780 CMR 1305.0	9
Equipment Controls	Humidistats, thermostats & zoning	780 CMR 1305.0,	9
Duct and Pipe Insulation and Construction	Located in or on buildings	780 CMR 1305.0	
Electrical Power Distribution.	-	780 CMR 1307.0	
Lighting	Lighting	780 CMR 1308.0	

Note 1. Wood plank and beam assemblies are constructions in which the finished interior surface is the underside of the roof deck.

Note 2. For existing low-rise residential buildings, commencing January 1, 1999, the maximum allowed thermal transmittance of replacement windows, with or without a storm window, shall be 0.44 and such windows and window with storm window combinations will be NFRC listed labeled. For all other existing building types (commercial/high-rise), window thermal transmittance requirements shall conform to the requirements of 780 CMR 13 generally and 780 CMR 1304.2 or 1304.5 or 1309, as applicable. Refer also to 780 CMR 3407.0 Exceptions 1 and 2.

Note 3. Insulation may be omitted from floors over unheated areas when foundation walls are provided with a U value of 0.17.

Note 4. The U value requirement of 0.17 for foundation walls may be omitted when floors over unheated spaces are provided with a U value of 0.08.

Note 5. Refer to 780 CMR Appendix J Table J4.3.2 for allowable air infiltration rates for residential doors and windows. Allowable rate for commercial doors is 11 cfm/lin. ft of operable sash crack.

NON-TEXT PAGE

Exception 1: Every bathroom and toilet room shall, as a minimum, be provided with artificial light.

Exception 2: All interior and exterior stairways shall be provided with artificial light providing direct or indirect illumination and capable of illuminating the entire length of the stairway and associated landings. The control for activation of the required interior stairway lighting shall be installed in accordance with the requirements of 527 CMR 12.00, the Massachusetts State Electrical Code, as listed in *Appendix A*. The illumination of exterior stairs shall be controlled from inside the dwelling

3603.6.2 Ventilation required: Every room or space intended for human occupancy shall be provided with natural or mechanical ventilation.

Exception: Every bathroom and toilet room shall be equipped with a mechanical exhaust fan and associated ductwork with the fan exhausting, as a minimum, at 50 cfm if operated intermittently or 20 cfm if continuously operated. Such bathroom exhaust shall vent directly to the outside and no exhaust vent termination to attics or other interior portions of the building are allowed.

3603.6.3 Heating required: One and two family dwellings shall be designed with heating systems complying with the requirements of 780 CMR 3603.21.

3603.6.4 Natural light

3603.6.4.1 General: Should natural lighting be chosen as a lighting option, in the application of the provisions of 780 CMR 3603.0 for habitable and occupiable rooms, unless otherwise specifically required by the provisions of 780 CMR 4 for special occupancies, the requirements of 780 CMR 3603.6.4.2 through 780 CMR 3603.6.4.6 shall apply.

3603.6.4.2 Minimum glazing area: Every room or space intended for human occupancy shall have an exterior glazing area of not less than 8% of the floor area. ½ of the required area of glazing shall be openable. Glazed openings shall be located such that they open directly onto a street or public alley, or a yard or court, or other open space located on the same lot as the building. Glazed openings are permitted to face into a roofed porch where the porch abuts a street, yard or court, or other open area and the longer side of the porch is at least 65% open and unobstructed and the ceiling height of the porch is not less than seven feet (2134 mm).

Exceptions:

1. Glazed areas need not be openable where the opening is not required by 780 CMR 3603.10.4 and an approved mechanical ventilation system is provided which is capable of producing 0.35 air change per hour in the room or a whole-house mechanical ventilation system is installed capable of supplying outdoor ventilation air of 15 cubic feet per minute (cfm) (7.08 L/s) per occupant computed on the basis of two occupants for the first bedroom and one occupant for each additional bedroom.
2. The glazed areas may be omitted in rooms where the opening is not required by 780 CMR 3603.10.4 and an approved mechanical ventilation system is provided capable of producing 0.35 air change per hour in the room or a whole-house mechanical ventilation system is installed capable of supplying outdoor ventilation air of 15 cfm (7.08 L/s) per occupant computed on the basis of two occupants for the first bedroom and one occupant for each additional bedroom, and artificial light is provided capable of producing an average illumination of six foot-candles (6.46 Ix) over the area of the room at a height of 30 inches (762 mm) above the floor level.

3603.6.4.3 Adjoining spaces: Where natural light for rooms or spaces without exterior glazing areas is provided through an adjoining room, the unobstructed opening to the adjoining room shall be at least 8% of the floor area of the interior room or space, but not less than 25 square feet ($2.33 m^2$). The exterior glazing area shall be based on the total floor area being served.

3603.6.4.4 Stairways: See 780 CMR 3603.6.1, Exception 2

3603.6.4.5 Hallways: Natural light shall be capable of penetrating the full length of the hallway.

3603.6.4.6 Bathrooms and toilet rooms: See 780 CMR 3603.6.1, Exception 1.

3603.6.5 Artificial light

3603.6.5.1 General: Artificial light shall be capable of providing the minimum illumination considered safe for the specific space application (an average illumination of six foot candles over the area of a room at a height of 30 inches above the floor is typically considered acceptable except for bathrooms and toilet rooms where three foot-candles, so measured is typically considered acceptable).

3603.6.6 Natural ventilation

3603.6.6.1 General: Natural ventilation of an occupied space shall be provided by means of windows, doors, louvers or other natural openings to the outdoor air.

3603.6.6.2 Ventilation area required: The minimum openable area to the outdoors shall be 4% of the floor area being ventilated.

3603.6.6.2.1 Adjoining spaces: Where rooms and spaces without openings to the outdoors are ventilated through an adjoining room, the unobstructed opening to the adjoining room shall be at least 8% of the floor area of the interior room or space, but not less than 25 square feet (2.33 m^2). The ventilation openings to the outdoors shall be based on the total floor area being ventilated.

3603.6.6.2.2 Bathrooms and toilet rooms: See 780 CMR 3603.6.2, Exception.

3603.6.6.2.3 Openings below grade: Openings below grade shall be acceptable for natural ventilation provided that the outside horizontal clear space measured perpendicular to the opening is 1½ times the depth below the average adjoining grade.

3603.6.6.3 Openings onto yards, courts or open areas: Natural ventilation shall be provided by openings onto yards, courts or other open space on the same lot.

3603.6.7 Mechanical ventilation

3603.6.7.1 General: Mechanical ventilation shall conform to the requirements of 780 CMR 36 and otherwise to the requirements of the BOCA National Mechanical Code listed in ***Appendix A***.

3603.6.8 Ventilation of special spaces

3603.6.8.1 Roof spaces: Enclosed attics and enclosed rafter spaces formed where ceilings are applied directly to the underside of roof rafters, shall have cross ventilation for each separate space by ventilation openings that are protected against the entrance of rain and snow. The openings shall be covered with corrosion-resistant mesh not less than ¼ inch (6 mm) nor more than ½ inch (13 mm) in any direction, or other approved screening which allows for ventilation.

3603.6.8.1.1 Ventilating area: The minimum required net free ventilating area for such roof spaces shall be $^1/_{150}$ of the area of the space ventilated, except that the minimum required area shall be reduced to $^1/_{300}$, provided that: a vapor retarder having a permeance not exceeding one perm is installed on the warm side of the ceiling; or at least 50% and not more than 80%, of the required ventilating area is provided by ventilators located in the upper portion of the space to be ventilated at least three feet (914 mm) above eave or cornice vents, with the balance of the required ventilation provided by eave or cornice vents.

3603.6.8.2 Basements, cellars and crawl spaces: All basements, cellars which are not used as *habitable, occupiable* space, and crawl spaces, shall be ventilated by openings in exterior foundation walls, by openable windows or by approved mechanical means. Openings or openable windows shall be located as near as practical to provide cross ventilation. The openings shall be covered with corrosion resistant mesh not less than ¼ inch (6 mm) nor more than ½ inch (13 mm) in any direction, or other approved screening which allows for ventilation except than when openable windows are used for basement or cellar ventilation, standard window screens may be used as the corrosion resistant mesh.

Note: Crawl spaces shall not be used as an underfloor plenem.

Exception:

1. Basements or cellars used as *habitable, occupiable space* (Typically basements and cellars are not classified as habitable, occupiable space - see Definitions, 780 CMR 2 and 1202) shall satisfy the ventilation requirements of 780 CMR 3603.6.6 or 780 CMR 3603.6.7, as applicable.
2. All basements and cellars containing solid fuel fired or fossil fired appliances shall additionally satisfy combustion air requirements of 780 CMR 3611.1

3603.6.8.2.1 Opening size: Openings or openable windows shall have a net area of not less than one square foot (0.093 m^2) for each 150 square feet (13.95 m^2) of foundation floor area. Where an approved vapor retarder is installed over the ground surface, the required net area of openings shall be reduced to 0.1 square foot (0.093 m^2) for each 150 square feet (13.95 m^2) and where vents are provided, they shall have manually operable louvers.

Exception: Basements and cellars not used as habitable, occupiable space shall be provided with a minimum of four sliding type, or awning type basement windows for every 1500 square feet of floor area, or multiples thereof, and shall be located, as near as practical, to provide cross ventilation.

3603.6.8.3 Alternative mechanical ventilation: Enclosed attics, rafter, basement, cellar and crawl spaces which are not ventilated as herein required shall be equipped with a mechanical ventilation system conforming to the requirements of the BOCA National Mechanical Code listed in ***Appendix A***.

780 CMR 3603.7 ROOM DIMENSIONS

3603.7.1 Floor area: Habitable rooms, except kitchens, shall have an area of not less than 70 square feet (6.51 m^2). Every kitchen shall have not less than 50 square feet (4.64 m^2) Habitable rooms, except kitchens shall not be less than seven feet (2134 mm) in any horizontal direction.

780 CMR 3603.8 CEILING HEIGHT REQUIREMENTS

3603.8.1 Minimum ceiling height: *Habitable rooms*, except kitchens, shall have a ceiling height of not less than seven feet three inches (2210 mm) for at least 50% of their required areas. Not more than 50% of the required area may have a sloped ceiling less than seven feet three inches (2210 mm) in height with no portion of the required areas less than five feet (1524 mm) in height. If any room has a *furred ceiling*, the prescribed ceiling height is required for at least 50% of the area thereof, but in no case shall the height of the *furred ceiling* be less than seven feet (2134 mm).

Exceptions:

1. Beams and girders spaced not less than four feet (1219 mm) on center may project not more than six inches (153 mm) below the required ceiling height.
2. All other rooms including kitchens, bathrooms and hallways shall have a minimum ceiling height of seven feet (2134 mm) measured to the lowest projection from the ceiling.
3. Habitable basements shall have a minimum clear ceiling height of seven feet zero inches, except that beams, girders and other obstructions spaced not less than four feet on center may project not more than six inches below the required ceiling height.
4. Basements not used for *habitable* spaces shall have a minimum clear ceiling height of six feet eight inches (2032 mm) except for under beams, girders, ducts or other obstructions where the clear height shall be a minimum of six feet four inches (1931 mm).

3603.8.2 Height effect on room area: Portions of a room with a sloping ceiling measuring less than five feet zero inches (1524 mm) or a *furred ceiling* measuring less than seven feet zero inches (2134 mm) from the finished floor to the finished ceiling shall not be considered as contributing to the minimum required habitable area for that room.

3603.8.3 Stairway ceiling height: Stairway headroom clearances shall be in accordance with the provisions of 780 CMR 3603.13.3.

780 CMR 3603.9 ACCESS TO CRAWL SPACES AND ATTICS

3603.9.1 Access to crawl spaces: Access shall be provided to crawl spaces by an opening not less than 18 inches (457 mm) by 24 inches (610 mm).

3603.9.2 Access to attics: An opening not less than 22 inches by 30 inches (559 mm by 762 mm) with ready access thereto shall be provided to any attic area having a clear height of over 36 inches (914 mm). Where doors or other openings are installed in the draftstopping, such doors shall be self-closing and be of approved materials as specified in this section, and the construction shall be tightly fitted around all pipes, ducts or other assemblies piercing the draftstopping.

780 CMR 3603.10 MEANS OF EGRESS

3603.10.1 Means of egress: Egress from all dwelling units shall be by means of two exit doors, remote as possible from each other and leading directly to grade. Such doors shall be provided at the normal level of entry/exit. In addition, all other floors within a dwelling unit shall have at least one means by which a continuous and unobstructed path to the exit doors, by means of stairways, corridors, hallways or combinations thereof, is provided.

Exception: In split level and raised ranch style layouts, the two separate exit doors required by 780 CMR 3603.10.1 are permitted to be located on different levels.

3603.10.2 Exit doors: One of the required exit doors required by 780 CMR 3603.10.1 shall be a side-hinged swinging door. The second exit door may be provided by a side-hinged swinging door or sliding type doors. Side hinged swinging doors provided to meet this requirement may swing inward.

3603.10.3 Door hardware: Double cylinder dead bolts requiring a key operation on both sides are prohibited on required means of egress doors serving more than one dwelling unit.

3603.10.4 Emergency egress from sleeping rooms: Sleeping rooms shall have at least one openable window or exterior door approved for emergency egress or rescue in each such room. The units shall be operable from the inside to a full clear opening without the use of a key or tool. Emergency escape windows, under 780 CMR 3603.10.4, shall have a sill height of not more than 44 inches (1118 mm) above the floor.

3603.10.4.1 Minimum size. All emergency escape windows from sleeping rooms shall have a net clear opening of 3.3 square feet (0.307 m^2). The minimum net clear opening shall be 20 inches by 24 inches in either direction.

Exception: Windows in sleeping rooms of existing dwellings which do not conform to the requirements of 780 CMR 3603.10.4.1 may be replaced without conforming to 780 CMR 3603.10.4.1, provided that the replacement windows do not significantly reduce the existing opening size.

3603.10.4.2 Bars, grills and screens: Bars, grills, screens or other obstructions placed over emergency escape windows shall be releasable or removable from the inside without the use of a key or tool.

3603.10.5 Exitway under stair protection: Enclosed accessible space under stairs shall have walls and soffits protected on the enclosed side with ½-inch (12.7 mm) gypsum board.

780 CMR 3603.11 DOORS AND HALLWAYS

3603.11.1 Exit doors: The minimum nominal width of at least one of the exit doors required by 780 CMR 3603.10.1 shall be 36 inches and the minimum nominal height shall be six feet eight inches. All other exit doors and doors leading to or from enclosed stairways, shall not be less than 32 inches in nominal width nor six feet eight inches in nominal height.

Exceptions:

1. Existing Buildings: New and replacement doors are permitted to be six feet six inches in nominal height.
2. Sliding type doors utilized as a second means of egress shall not be less than six feet six inches in nominal height.

3603.11.2 Interior Doors: All doors providing access to habitable rooms shall have a minimum nominal width of 30 inches and a minimum nominal height of six feet six inches.

Exception:

1. Doors providing access to bathrooms are permitted to be 28 inches in nominal width.
2. Existing Buildings: Doors providing access to bathrooms are permitted to be 24 inches in nominal width.

780 CMR 3603.12 LANDINGS

3603.12.1 General: A minimum of three foot by three foot (914 mm by 914 mm) landing or open floor area shall be provided at the interior side of all exit doors. A minimum 48 inches wide by 42 inches deep landing shall be provided on the exterior side of all exit doors. The floor area or landing shall not be more than 1½ inches (38 mm) lower than the top of the threshold on the interior side, nor more than 8¼ inches lower than the threshold on the exterior side.

Exceptions:

1. At the top of a flight of interior stairs, on the stairway side, provided the door does not swing over the stairs.
2. For sliding type doors, or other doors where the threshold is located eight inches or less above the adjacent exterior finished grade.

780 CMR 3603.13 STAIRWAYS

3603.13.1 Width: Stairways shall not be less than 36 inches (914 mm) in clear width at all points above the permitted handrail height and below the required headroom height. The minimum width at and below the handrail height shall not be less than 32 inches (813 mm) where a handrail is installed on one side and 28 inches (711 mm) where handrails are provided on both sides.

3603.13.2 Treads and risers: The maximum riser height shall be 8¼ inches (210 mm) and the minimum tread depth shall be nine inches (229 mm). The riser height shall be measured vertically between leading edges of the adjacent treads. The tread depth shall be measured horizontally between the vertical planes of the foremost projection of adjacent treads and at a right angle to the tread's leading edge. The walking surface of treads and landings of a stairway shall be sloped no steeper than one unit vertical in 48 units horizontal (2% slope). The greatest riser height within any flight of stairs shall not exceed the smallest by more than ⅜ inch (9.5 mm) and any two successive risers shall not deviate by more than $^3/_{16}$-inch in height. The greatest tread depth within any flight of stairs shall not exceed the smallest by more than ⅜ inch (9.5 mm) and any two successive treads shall not deviate in depth by more than $^3/_{16}$-inch.

3603.13.2.1 Nosings: Nosings shall not project more than 1½ inches beyond the face of the riser below.

3603.13.3 Headroom: The minimum headroom in all parts of the stairway shall not be less than six feet six inches (1981 mm) measured vertically from the sloped plane adjoining the tread nosing or from the floor surface of the landing or platform.

3603.13.4 Winders: Winders are permitted, provided that the width of the tread at a point not more than 12 inches (305 mm) from the side where the treads are narrower is equal to the tread depth of the straight run portion of the stairs and the minimum width of any tread is not less than six inches (153 mm). The continuous handrail required by 780 CMR 3603.14.1 shall be located on the side where the tread is narrower.

3603.13.5 Spiral stairs: Spiral stairways are permitted, provided the minimum width shall be 26 inches (660 mm) with each tread having a 7½-inch

(190 mm) minimum tread width at 12 inches (305 mm) from the narrow edge. All treads shall be identical, and the rise shall be no more than 9½ inches (241 mm). A minimum headroom of six feet six inches (1982 mm) shall be provided.

3603.13.6 Circular stairways: Circular stairways shall have a minimum tread depth and a maximum riser height in accordance with 780 CMR 3603.13.2 and the smaller radius shall not be less than twice the width of the stairway. The minimum tread depth of ten inches (254 mm) shall be measured from the narrower end.

3603.13.7 Illumination: All stairways shall be provided with artificial illumination in accordance with 780 CMR 3603.6.1 (exception 2).

780 CMR 3603.14 HANDRAILS AND GUARDRAILS

3603.14.1 Handrails:

3603.14.1.1 Handrails: Handrails having minimum and maximum heights of 30 inches and 38 inches (762 mm and 965 mm), respectively, measured vertically from the nosing of the treads, shall be provided on at least one side of stairways of three or more risers. Spiral stairways shall have the required handrail located on the outside radius. All required handrails shall be continuous the full length of the stairs. Ends shall be returned or shall terminate in newel posts or safety terminals. Handrails adjacent to a wall shall have a space of not less than 1½ inches (38 mm) between the wall and the handrail.

Exceptions:
1. Handrails shall be permitted to be interrupted by a newel post at a turn.
2. The use of a volute, turnout or starting easing shall be allowed over the lowest tread.

3603.14.1.2 Handrail grip size: Stairway handrails shall have a circular cross section with an outside diameter of at least 1¼ inches and not greater than two inches.

Exceptions:
1. Any other shape with a perimeter dimension of at least four inches but not greater than 6¼ inches (159 mm) with the largest cross-sectional dimension not exceeding 2⅝ inches.
2. Approved handrails of equivalent graspability.

3603.14.2 Guardrails:

3603.14.2.1 Guardrail details: Porches, balconies, decks or raised floor surfaces located more than 30 inches (762 mm) above the floor or grade below shall have guardrails not less than 36 inches (914 mm) in height. Open sides of stairs with a total rise of more than 30 inches (762 mm) above the floor or grade below shall have guardrails, which may also serve as handrails, not less than 34 inches (864 mm) in height measured vertically from the nosing of the treads.

3603.14.2.2 Guardrail opening limitations: Required guardrails on open sides of stairways, balconies, porches, decks and raised floor areas, shall have intermediate rails, balusters or ornamental closures which prevent the passage of an object five inches (127 mm) or more in diameter.

Exception: Triangular spaces formed by the riser, tread and bottom rail of a guard at the open side of a stairway may be of sized to prevent the passage of a sphere six inches (153 mm)in diameter.

780 CMR 3603.15 RAMPS

3603.15.1 Maximum slope: All egress ramps shall have a maximum slope of one unit vertical in eight units horizontal (12.5% slope).

Exception 1: The maximum slope of ramps for persons with disabilities shall be one unit vertical in 12 units horizontal.
Exception 2: Where access for persons with disabilities is legally mandated, ramps shall be constructed in accordance with the requirements of 521 CMR as listed in *Appendix A*.

3603.15.2 Guardrails and handrails: Guardrails shall be provided on both sides of all ramps and shall be constructed in accordance with 780 CMR 3603.14.2. Handrails conforming to 780 CMR 3603.14.1 shall be provided on at least one side of all ramps exceeding a slope of one unit vertical in 12 units horizontal (8% slope).

Exception 1: For persons with disabilities, handrails shall be provided on both sides of the ramp when the vertical rise between landings exceeds six inches.
Exception 2: Where access for persons with disabilities is required by statute, ordinance or bylaw, guardrails and handrails shall be provided in accordance with the requirements of 521 CMR as listed in *Appendix A*.

3603.15.3 Landing required: A minimum three-foot-by-three-foot (914 mm by 914 mm) level landing shall be provided at the top and bottom of ramps where doors open onto the ramp and where the ramp changes direction.

Exception 1: Ramps required for persons with disabilities shall not have a vertical rise greater than 30 inches between landings.
Exception 2: Where access for persons with disabilities is legally mandated, landing requirements shall conform to the requirements of 521 CMR as listed in *Appendix A*.

780 CMR 3603.16 FIRE PROTECTION SYSTEMS

3603.16.1 General: All one and two family dwellings hereafter constructed shall be equipped with a *household fire warning system*, in accordance with the provisions of 780 CMR 3603.16. All devices shall be installed and maintained in accordance with the requirements of 780 CMR 3603.16, manufacturers instructions and listing criteria and otherwise shall be installed and maintained in accordance with Chapter 2 of NFPA 72 and 527 CMR 12.00 as listed in *Appendix A*.

> **Exception:** In addition to the requirements of 780 CMR 3603.16.1, two family dwellings that contain common areas such as basements, hallways and/or interior stairways that serve both dwelling units, but are not within the dwelling units shall be provided with multiple station smoke detectors or a listed control unit with automatic smoke detectors and occupant notification appliances in the following locations.
>
> 1. In all common basements.
> 2. In all common hallways.
> 3. In all common stairways on each level outside the dwelling unit doorways.
>
> Each detection device shall cause the operation of an alarm that is clearly audible in all bedrooms over background noise levels with all intervening doors closed. Such devices shall be installed in accordance with NFPA 72 and 527 CMR 12.00 as listed in *Appendix A*.

3603.16.2 Compatibility: All devices and/or combination of devices and equipment shall be approved and listed for the purposes for which such devices are to be utilized.

3603.16.3 Smoke detectors: All detached one- and two family buildings, including *manufactured homes* in accordance with 780 CMR 35, shall contain listed single and multiple station smoke detectors or other *household fire warning systems* in compliance with ANSI/UL 217 and/or ANSI/UL 268 (listed in Appendix A) and conforming to 780 CMR 3603.16; *such household fire warning systems* shall be installed and maintained in accordance with the requirements of 780 CMR 3603.16, manufacturers instructions and listing criteria and otherwise shall be installed and maintained in accordance with Chapter 2 of NFPA 72 and 527 CMR 12.00 as listed in *Appendix A*.

3603.16.4 Heat detectors: (Reserved).

3603.16.5 Primary electrical power for single station and multiple station smoke detectors: Power for single and multiple station smoke detectors shall be supplied from a permanently wired connection directly to an AC primary source of power. All power for AC powered smoke detectors shall be taken from a single branch circuit which also provides other electrical service to *habitable, occupiable spaces*. The power source shall be on the supply side, ahead of any switches.

3603.16.6 Primary electrical power for other *household fire warning systems*: Low voltage *household fire warning systems* that include a listed control unit with automatic detectors and occupant notification appliances shall be powered from a permanently wired AC primary power source. Such AC primary power shall be supplied either from a dedicated branch circuit or the unswitched portion of a branch circuit also used for power and lighting of *habitable, occupiable spaces*, in accordance with the requirements of NFPA 72 and 527 CMR 12.00 as listed in *Appendix A*.

3603.16.7 Secondary electrical power: In addition to required primary power as discussed in 780 CMR 3603.16.5 and 780 CMR 3603.16.6, all household fire warning systems shall have secondary (standby) power supplied from monitored batteries in accordance with the household fire warning equipment requirements of NFPA-72 as listed in *Appendix A*.

3603.16.8 Required alarm notification appliances: Where more than one smoke or heat detector is required by 780 CMR 3603.16.10, all required detectors shall be installed so that the activation of any detector shall cause the alarm in all required smoke detectors in the dwelling unit to sound.

Detector activation in a dwelling unit shall not activate signals in any other dwelling unit or common areas.

3603.16.9 Alarm signaling intensity: All required alarm-sounding appliances shall have a minimum rating of 85 dBA at ten feet in accordance with the requirements of NFPA 72.

> **Exception:** Sounding appliances directly located in bedrooms shall have a sound pressure level as low as 75 dBA at ten feet in accordance with the requirements of NFPA 72.

3603.16.10 Required smoke detector/heat detector locations: Smoke detectors shall be installed in the following locations:

1. In the immediate vicinity of bedrooms;
2. In all bedrooms;

Standard reference number	Title	Referenced in 780 CMR Section number
D3909-95a	Specification for Asphalt Roll Roofing (Glass Felt) Surfaced with Mineral Granules	1507.2.2, Table 1507.3.1
D3966-90	Test Method for Piles Under Lateral Loads	1817.6.2
D4099-89	Specification for Poly (Vinyl Chloride) (PVC) Prime Wndows	3606.8.1
D4272-90a	Test Method for Total Energy Impact of Plastic Films by Dart Drop	1505.3.2
D4434-87	Specification for Poly (Vinyl Chloride) Sheet Roofing	1507.3.3
D4601-95	Specification for Asphalt Coated Glass Fiber Base Sheet Used in Roofing	Table 1507.3.1
D4637-87	Specification for Vulcanized Rubber Sheet Used in Single-Ply Roof Membrane	1507.3.2
D5055-95a	Specification for Establishing and Monitoring Structural Capacities of Prefabricated Wood I-Joists	2313.5
E72-95	Methods of Conducting Strength Tests of Panels for Building Construction	2305.7
E84-95b	Test Method for Surface Burning Characteristics of Building Materials	412.3.6.3, 428.11, 704.4.1.2, 722.2, 722.3, 803.2, 803.3.2, 2310.2, 2601.2, 2603.3, 2603.6.3, 2603.7.4, 2604.1, 2805.2.2, 3105.3, 3603.17.1.1, 3603.17.2.6, 3603.17.3, 3603.18.3, 3603.19.1, 3603.19.2, 3612.2
E90-90	Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions	1214.2, 3603.4.3.1
E96-90	Standard Test for Water Vapor Transmission of Materials	
E108-95	Test Methods for Fire Tests of Roof Coverings	1506.1, 1506.2, 2608.2, 2608.3
E119-95a	Test Methods for Fire Tests of Building Construction and Materials	412.3.6.2, 704.1.1, 705.2.4 705.4, 707.7.2, 707.7.3, 707.8.1.2, 709.6.1, 709.6.2, 709.6.4, 709.7.1.2, 713.4.2, 2105.2, 2603.4, 3603.4.1
E136-95	Test Method for Behavior of Materials in Vertical Tube Furnace at 750°C	704.4.1.1, 3612.2
E152-81a	Methods of Fire Tests of Door Assemblies	716.1, 716.1.1, 3603.17.3
E163-84	Methods of Fire Tests of Window Assemblies	718.1, 719.1
E283-91	Test Method for Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified PressureDifferences Across the Specimen	3606.8.2, 3606.9.2
E492-90	Test Method for Laboratory Measurement of Impact Sound Transmission Through Floor-Ceiling Assemblies Using the Tapping Machine	1214.3, 3603.4.3.3
E648-95	Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source	805.2
E814-94b	Test Method for Fire Tests of Through-Penetration Fire Stops	707.7.2, 707.7.3, 709.6.1, 709.6.2, 713.4.1
E838-81	Practice for Performing Accelerated Outdoor Weathering Using Concentrated Natural Sunlight	1505.3.1
E970-89	Test Method for Critical Rdiant Flux of Exposed Attic Floor Insulation Using a Radiant Heat Energy Sources	3603.19.4
E1509-	Specification for Room Heaters, Pellet Fuel-Burning Type	
G23-95	Practice for Operating Light- Exposure Apparatus (Carbon- Arc Type) With and Without Water for Exposure of Nonmetallic Materials	1505.3.1
G26-95	Practice for Operating Light- Exposure Apparatus (Xenon- Arc Type) With and Without Water for Exposure of Nonmetallic Materials	1505.3.1
G53-95	Practice for Operating Light- and Water- Exposure Apparatus (Fluorescent UV - Condensation Type) for Exposure of Nonmetallic Materials	1505.3.1

AWPA **American Wood Preservers Association**
P.O. Box 5690
Granbury, TX 76049
(1-817-326-6300)

Standard reference number	Title	Referenced in 780 CMR Section number
C1-95	All Timber Products -Preservative Treatment by Pressure Processes	1506.3, 2311.3, 3603.22.3.1
C2-95	Lumber, Timber, Bridge Ties and Mine Ties -Preservative Treatment by Pressure Processes	1808.1, 1808.2, 2311.3, 2311.4, 2311.5, 2311.7, 3603.22.3.1, 3603.22.4
C3-97	Piles - Preservative Treatment by Pressure Processes	1808.1, 1822.2, 3603.22.3.1
C4-95	Poles - Preservative Treatment by Pressure Processes	3603.22.3.1
C9-95	Plywood- Preservative Treatment by Pressure Processes	2311.3, 2311.4, 2311.5, 2311.7, 3603.22.3.1, 3603.22.4
C15-90	Wood for Commercial-Residential Constrruction Preservative Treatment by Pressure Process	3603.22.3.1
C18-90	Standard for Pressure-treated Material in Marine Construction	3603.22.3.1
C20-93	Structural Lumber - Fire- Retardant Treatment Pressure Processes	2310.2, 3603.22.3.1
C22-93	Lumber and Plywood for Permanent Wood Foundations - Preservative Treatment by Pressure Processes	1808.3, 3603.22.3.1, 3604.2.1.2, 3605.4.3
C23-84	Round Poles and Posts Used in Building Construction, Preservative Treatment by Pressure Process	3603.22.3.1
C24-86	Sawn Timber Piles Used for Residential Commerce Building	3603.22.3.1
C27-93	Plywood- Fire-Retardant Treatment by Pressure Process	2310.2, 3603.22.3.1
C28-90	Standard for Preservative Treatment of Structural Glues-Laminated Members and Laminations Before Cluing of Southern Pine, Pacific Coast Douglas Fir, Hem-fir and Western Hemlock by Pressure Process.	
M4-95	Standard for the Care of Preservative- Treated Wood Products	1822.2
P1/P13-95	Standard for Coal Tar Creosote for Land and Fresh Water and Marine (Coastal Water) Use	2311.3, 3603.22.3.1
P2-95	Standard for Creosote Solutions	2311.3, 3603.22.3.1
P3-89	Standard for Creosote - Petroleum Oill Solution	3603.22.3.1
P5-95	Standards for Waterborne Preservatives	2311.3, 3603.22.3.1, 3604.2.1.2
P8-95	Standards for Oil- Borne Preservatives	2311.3, 3603.22.3.1
P9-92	Standards for Solvents and Formulations for Organic Preservative Systems	2311.3, 3603.22.3.1

AWS **American Welding Society**
550 N.W. Lejeune Road
P.O. Box 351040
Miami, Florida 33135

Standard reference number	Title	Referenced in 780 CMR Section number
D1.1-92	Structural Welding Code- Steel	1705.5.3.2.1
D1.4-92	Structural Welding Code- Reinforced Steel	1906.5.2

Standard reference number	Title	Referenced in 780 CMR Section number
82-94	Incinerators, Waste and Linen Handling Systems and Equipment	2807.1
90A-96	Installation of Air Conditioning and Ventilation Systems	
90B-96	Installation of Warm Air Heating and Air Conditioning Systems	
92A-96	Smoke Control Systems	
92B-95	Smoke Management System in Malls, Atria and Alrge Areas	
96-98	Ventilation Control and Fire Protection of Commercial Cooking Operations	
99-96	Health Care Facilities	2809.1, 2809.2
101-94	Life Safety Code	
102-95	Assembly Seating, Tents and Membrane Structures	3104.4
120-94	Coal Preparation Plants	418.3.1
130-95	Standard for Fixed Guideway Systems	
211	Chimney, Fireplace and Vents	3610.4
231-95	General Storage	426.3, 426.6
231C-95	Rack Storage of Materials	507.1, 426.3, Table 922.2
231D-94	Storage of Rubber Tires	426.3, 426.6
241-96	Safeguarding Construction, Alteration and Demolition Operations	903.1.5, 915.1, 914.7.2
259-87	Standard Test Method for Potential Heat of Building Materials	3603.17.2.5
409-95	Aircraft Hangers	426.3, 426.5, 426.6
416-93	Construction and Protection of Airport Terminal Buildings	
418-95	Roof-top Heliport Construction and Protection	1511.3
430-95	Storage of Liquid and Solid Oxidizers	426.3, 426.5, 426.6
495-96	Explosive Material Code	417.5.1 *See also 527 CMR*
502-96	Access Highways, Tunnels, Bridges, Air Right Structures	
651-93	Manufacture of Aluminum or Magnesium Powder	418.3.1
654-94	Prevention of Fire, and Dust Explosions in the Chemical, Dye, Pharmaceutical, and Plastics Industries	418.3.1
655-93	Prevention of Sulfur Fires and Explosions	418.3.1
664-93	Prevention of Fires and Explosions in Wood Processing and Woodworking Facilities	418.3.1
701-96	Standard Methods of Fire Tests for Flame Resistant Textiles and Films	807.2, 807.2.2, 3102.6.4.2, 3103.3.2, 3104.5, 3105.3
704-96	Identification of the Fire Hazards of Materials	416.2, 416.15.1
750-96	Installation of Water Mist Fire Protection Systems	
8503-96	Pulverized Fuel Systems	418.3.1

NFoPA
(AFPA)

American Forest and Paper Association*
1250 Connecticut Avenue, N.W./ Suite 200
Washington, D.C. 20036

Standard reference number	Title	Referenced in 780 CMR Section number
NDS-97	National Design Specification for Wood Construction -with 1997 Supplement; Design Values for Wood Construction	1801.1, 2303.1, 2304.1, 2305.14.1, 2305.15, 2306.4, 2306.4.5.1, 2306.4.5.2, 2306.4.6, 2306.4.6.1.1, 2306.4.6.2.1, 2306.4.7.1.1, 2306.4.7.2.1, 2312.1, 2312.4, 2313.3.1, 2313.3.2
TR7-87	Basic Requirements for Permanent Wood Foundation System	1808.3, 1813.3, 2311.3.3

**The National Forest Products Association (NFoPA) has changed their name to the American Forest and Paper Association (AFPA). The referenced standard in this code may be identified with the designation AFPA.*

RCSC

Research Council On Structural Connections
c/o American Institute of Steel Construction, Inc.
Suite 3100
One East Wacker Drive
Chicago, IL 60601-2001

Standard reference number	Title	Referenced in 780 CMR Section number
RCSC-85	Specifications for Structural Joints Using A325 or A490 Bolts	1705.5.3.2.1
RCSC-88	Specification for Load and Resistance Design	

RMA

Rubber Manufacturers Association
1200 K Street, N.W.
Washington, D.C. 20005

Standard reference number	Title	Referenced in 780 CMR Section number
RP-1- 90	Minimum Requirements for Non- Reinforced Black EPDM Rubber Sheets	1507.3.2
RP-2-90	Minimum Requirements for Fabric- Reinforced Black EPDM Rubber Sheets	1507.3.2
RP-3-85	Minimum Requirements for Fabric- Reinforced Black Polychlorprene Rubber Sheets	1507.3.2

SJI

Steel Joist Institute
1205 48th Avenue North
Suite A
Myrtle Beach, South Carolina 29577

Standard reference number	Title	Referenced in 780 CMR Section number
SJI-94	Standard Specifications, Load Tables and Weight Tables for Steel Joists and Joist Girders	2205.1

SMACNA

Sheet Metal and Air Conditioning Contractors
National Association, Inc.
4201 Lafayette Center Drive
Chantilly, VA 22021

Standard reference number	Title	Referenced in 780 CMR Section number
SMACNA-88	Installation Standards for Residential Heating and Air Conditioning Systems	3619.1.3.1

TFS

Texas Forest Service
Forest Products Laboratory
P.O. Box 310
Lufkin, Texas 75902-0310

Standard reference number	Title	Referenced in 780 CMR Section number
TFS-90	Grading Rules for Preservative Treated Southern Yellow Pine Tapersawn Shakes	1507.2.9

The Commonwealth of Massachusetts
Executive Office of Public Safety
State Board of Building Regulations and Standards
McCormack State Office Building
One Ashburton Place - Room 1301
Boston, Massachusetts 02108

WILLIAM F. WELD
Governor

KATHLEEN M. O'TOOLE
Secretary

TEL: (617) 727-3200 FAX: (617) 227-1754

KENTARO TSUTSUMI
Chairman

THOMAS L. ROGERS
Administrator

STATE BUILDING CODE APPEALS BOARD - SERVICE NOTICE

I, ______________________________, as ____________________ for the

Appellant/Petitioner ______________________________ in an appeal filed with the

State Building Code Appeals Board on ____________________, 19____

HEREBY SWEAR UNDER THE PAINS AND PENALTIES OF PERJURY THAT IN ACCORDANCE WITH THE PROCEDURES ADOPTED BY THE STATE BOARD OF BUILDING REGULATIONS AND STANDARDS AND SECTION 122.3.1 OF THE STATE BUILDING CODE, I SERVED OR CAUSED TO BE SERVED, A COPY OF THIS APPEAL APPLICATION ON THE FOLLOWING PERSON(S) IN THE FOLLOWING MANNER:

NAME AND ADDRESS OF PERSON/AGENCY SERVED	METHOD OF SERVICE	DATE OF SERVICE
______________________		
______________________	____________________	________________
______________________		
______________________		
______________________	____________________	________________
______________________		

____

Signature: APPELLANT/PETITIONER

On the __________ Day of ____________________ 19 ____, PERSONALLY APPEARED

BEFORE ME THE ABOVE NAMED ______________________________
(Type or Print the Name of the Appellant)

AND ACKNOWLEDGED AND SWORE THE ABOVE STATEMENTS TO BE TRUE.

______________________ ______________________

NOTARY PUBLIC MY COMMISSION EXPIRES

ENERGY CONSERVATION MANDATORY CHECKLIST FOR NEW CONSTRUCTION (OTHER THAN LOW-RISE RESIDENTIAL) 780 CMR, 1301.8.1

Owner/Agent Name: ______________________ Phone: __________

Owner/Agent Address: ______________________

City/State/Zip: ______________________

Project Name: ______________________

Site Address: ______________________ City/Town __________

Applicant's Name: ______________________ Signature: __________

Applicant's Phone: ______________________ Date of Application: __________

I. Envelope Compliance Option (check ONE)

☐ **Trade-Off** (1304.5) - Attach software Compliance Report (COMcheck-EZ)

☐ **Appendix J** (1301.2 - For buildings up to 10,000 sf only) - Attach Appendix J compliance documentation

☐ **Systems Analysis** (1309) - Attach Registered Architect's or Engineer's report

☐ **Prescriptive** (1304.2) - Complete this section, and attach copy of applicable Table (1304.2.1 through 13.4.2.12)

Climate Zone (from Table 1303.1) ☐ Zone 12a ☐ Zone 13a ☐ Zone 14a

a. Gross above-grade wall area __________sq.ft.

b. Total window & glass door area __________sq.ft.

c. Glazing % (100 x b÷a) __________% Table # utilized: __________

II. HVAC (check ONE)

☐ Simple Systems & Equipment (1305.2) ☐ Complex Systems & Equipment (1305.3)

☐ Systems Analysis (1309) - Attach Registered Architect's or Engineer's report

---

III. Lighting (check ONE)

☐ Building Area Method (1308.6.2.1)
☐ Space-by-Space Method (1308.6.2.2) } Attach Compliance Documentation (COMcheck-EZ or other)
☐ Systems Analysis (1309) - Attach Registered Architect's or Engineer's report

---

IV. Approval & Acceptance Construction Documents (1301.8.4.1)

Attach a narrative report describing the HVAC, Lighting, and Electric Distribution systems, including:

For Official Use ONLY		
Building Official check off completed sections of report	☐	1. Design Intent
	☐	2. Basis of Design
	☐	3. Sequence of operation / systems interaction
	☐	4. Description of the systems (capacities, etc.)
	☐	5. Testing requirements / criteria acceptance
	☐	6. Requirement for submittal of operation manuals and maintenance manuals
	☐	7. Requirement for submittal of record drawings and control documents

This Side For Use by Building Department Only

Official's Name: ______________________ Title: ______________

I. Plans Review

Date Application Received: ______________________

☐ Complete Narrative Report Received (1301.8.4.1)

☐ Design and Specification Documents prepared by legally recognized professional (1301.8.4.3)

Application is: Approved ☐ Date: __________ Signature: ____________________

Denied ☐ Date: __________

Reason(s) for Denial: (provide additional details as needed on separate sheet)

II. Acceptance (1301.8.4.4)

☐ Successful system tests witnessed by Building Official, **OR** ☐ satisfactory test report received (check one)

☐ Certification by Registered Professional (per 780 CMR 116.2) that systems are installed in accordance with construction documents

☐ Confirmation by owner (or their authorized representative) that they have received record drawings, reviewed for reasonable accuracy

☐ Confirmation by owner (or their authorized representative) that they have received reports, controls documentation, operations manual(s), maintenance manual(s), and other documents specified in 1301.8.4.1

Building Official's Signature: ______________________________

CONSUMER INFORMATION FORM - "SUNROOMS"

Massachusetts State Building Code (780 CMR, Appendix J, Section J1.1.2.3.1)

The Massachusetts State Building Code *(780 CMR)* includes provisions to ensure that houses and house additions meet energy efficiency standards. This supplemental CONSUMER INFORMATION FORM is to be filed as part of the building permit application when a builder/contractor or homeowner, constructing/installing a house addition with very large percentage of glass to opaque wall, seeks to utilize a special energy conservation exemption option for "sunroom" additions to an existing house (780 CMR, Appendix J, Section J1.1.2.3.1). This FORM is not intended to prevent a homeowner from selecting a "sunroom" of any size, configuration, orientation, form of construction or percent glazing, but rather is only intended to assist homeowners in becoming aware of some of the important energy conservation and year-round comfort considerations involved in selecting and utilizing a "sunroom" addition.

The connection of "sunroom" structures to residential buildings may create comfort and energy consumption issues due to uncontrolled solar gain or uncontrolled radiation cooling of the main house. In the selection and construction/installation of "sunrooms", included below is a non-required, open-ended list of product and design considerations that a homeowner may wish to consider before actually constructing/installing a "sunroom". It is recommended that consumers carefully review these options with their designer, builder, or contractor, in order to minimize potential energy consumption and/or house discomfort issues. In addition, the qualifications and reputation of the company or individuals to be hired are important considerations.

PRODUCT AND DESIGN CONSIDERATIONS RELATED TO "SUNROOMS"

- **Solar Orientation and Natural Shading**
- **Type of Glazing**
  - **Insulating value**
  - **Solar heat gain**
  - **Frame materials**
  - **Glazing to frame sealing and gasketing materials/ seal durability and/or weather tightness of the sunroom**
- **Adequate ventilation - Operable windows and fans**
- **Applied Shading Systems**
- **Insulation level in floors, walls, and ceilings**
- **Possible Sunroom isolation from the main house via a wall and/or door or slider**
- **Heating and Cooling Methods: Efficiency, Zoning and Controls**

Homeowner Acknowledgment

The Massachusetts State Building Code, Section J1.1.2.3.1, requires that the actual property owner (not the owner's agent or representative) acknowledge receipt of this CONSUMER INFORMATION FORM prior to issuance of a Building Permit for a project that includes "sunroom" additions to an existing residential building. In accordance with this requirement, the undersigned hereby acknowledges that she/he has read the information in this document concerning sunroom comfort and energy conservation.

Signature of Actual Building Owner

Date

Print Name

Address of Permitted Project

Owner Address (if different than project location)

Owner's telephone number

Official Interpretation No. 50-98

DATE: January 28, 1999

SUBJECT: Height and Area Requirements for Type 5B, One and Two-Family Dwellings as Defined by the Sixth Edition of the Code

Background:

A one- or two-family dwelling designed and constructed as an R-4 Use in accordance with the provisions of Chapter 36 of the Sixth Edition of the Code is typically built of Type 5B Construction. Chapter 36 does not define a one- or two- family structure in terms of its construction type. Referencing the definition section of this chapter, we learn only the number of lodgers and/or boarders legally allowed to occupy each dwelling, but do not learn much about the structure itself. However, the materials generally employed in one- and two-family dwelling construction most closely resemble those used in a Type 5B building as defined in Chapter 6 of the base code.

Also, Chapter 36 does not provide guidance in respect to the maximum size of a one-or two-family dwelling in terms of its height above grade (number of stories, and dimensional height) or in terms of its square foot area per floor.

Question: Absent this information, how does one determine the maximum size of a one and two-family dwelling building (both in terms of stories above grade and maximum square foot area per floor) if it is designed and constructed as an R-4 Use according to the provisions of Chapter 36?

Answer: Since Chapter 36 does not provide the answers we seek, we must first turn to Chapter 3, Section 310.6 which defines an R-4 structure as a "*detached one- or two-family dwelling(s) not more than* ***three stories*** *in height, and (its) accessory structures.*" This section states further that "*All such structures shall be designed in accordance with 780 CMR 36 (Chapter 36 of the Sixth Edition) or in accordance with the requirements of 780 CMR (this code) applicable to Use Group R-3*".

This section provides the code user with two distinct options for the design and construction of R-4 structures (detached one or two family dwellings and their accessory structures). Option 1; design in accordance with Chapter 36. Option 2; design in accordance with the requirements applicable to R-3 structures.

Question: Does this mean that such buildings may be designed and constructed with habitable floors **three stories** above the exterior grade plane?

Answer: Yes. However, one must assure that all applicable code requirements are satisfied for all inhabited floors including the upper-most floor (i.e.: light, ventilation, means of egress requirements, etc.).

At times, depending upon the configuration of the exterior grade, it may be difficult to determine the number of stories above which a building projects. Therefore, we have provided examples of buildings correctly configured under this definition. (See Figures 1a and 1b).

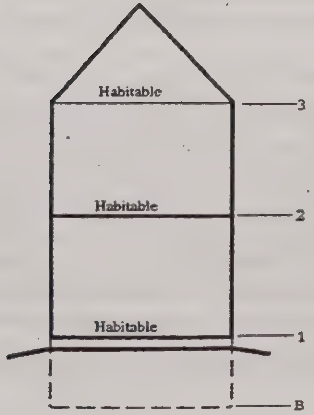


Figure 1a.

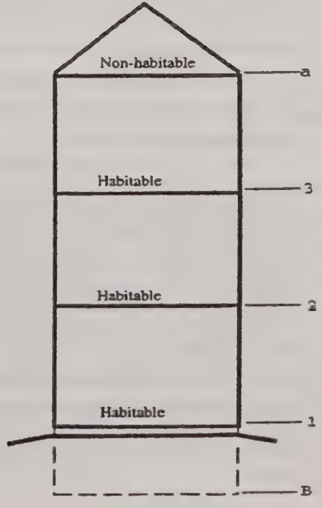


Figure 1b.

Note: Figures 1a and 1b illustrate typical gable roof, single family dwellings. Figure 1a depicts a dwelling consisting of three floors of habitable space and a basement. Figure 1b shows a dwelling consisting of three floors of habitable space, a basement and attic space above the third floor. Assuming requirements set by local zoning ordinances are met, each structure as depicted satisfies building code requirements in terms of its allowable number of stories above grade. However, be cautioned that the attic area shown in Figure 1b shall only be used as storage (**not habitable or occupiable**) space.

Question: Figure 1b illustrates a structure with attic space as the upper-most level. How does one distinguish habitable space from attic space?

Answer: *Habitable space* is defined in Chapter 2 of the code as *"space in a structure for living, sleeping, eating, or cooking. Bathrooms, toilets compartments, closets, halls, storage or utility space and similar areas are not considered habitable space"*. *Attic* is defined in Chapter 12 as *"the space between the ceiling beams of the top story and the roof rafters"*.

Attic space may only be provided if it does not constitute an additional story (i.e.: the head height and other conditions of this area do not allow for human occupancy. **Remember that by definition, the structure may only be three stories in height above the exterior grade plane.**

Question: Since bathrooms are not considered habitable space, is it permissible to locate a bathroom in this attic level?

Answer: No. The upper-most level, as illustrated in Figure 1b, is intended to be used as **storage** or **utility** space only and is limited by one or more construction features which fall short of that required for habitable or occupiable space (i.e.: ceiling height measures less than seven (7) feet, structural members will support only loads that are less than that required for habitable space, or room dimensions measure less than required, etc.).

Question: What about an existing, two story home with attic space; may it be converted into a three story structure with each floor made habitable?

Answer: Again, the key to this question is, does the attic comply with **all** applicable sections of Chapter 36 for habitable spaces (i.e.: design loads, light, ventilation, means of egress, etc.). If the answer is yes, then the structure may be converted. If portions of the third story do not satisfy code requirements (i.e.: the access stair is too narrow or rise and run dimensions are not satisfactory) the building official must reject the permit application. However, an applicant may seek relief through administrative appeal procedures (the Building Code Appeals Board) as defined in Chapter 1, Section 126, or offer compliance alternatives as defined in Chapter 34 of the code.

Question: Is a walk-out basement defined as a story above grade, and is it considered to contribute to the height of the building?

Answer: Chapter 5, Section 502.1 defines a story above grade as *"Any story having its finished floor surface entirely above grade except that a basement shall be considered as a story above grade where the finished surface of the floor above the basement is:*

1. *More than six feet (1829mm) above [the] grade plane;*
2. *More than six feet (1829 mm) above the finished ground level for more than 50% of the total building perimeter, or*
3. *More than 12 feet (3658mm) above the finished ground level at any point"*.

As demonstrated by the definition above, the answer to this question is dependent upon exterior grade conditions; which makes sense. The code limits the number of stories above grade which a building may be constructed as a direct function of an occupant's ability to exit the building in the event of an emergency. The higher up in the building one resides, the farther one must travel to exit the building. In a fire condition, the code is concerned with smoke conditions in open stairwells and other factors that may limit one's ability to escape from a building. Consequently, a walk-out basement (or any basement meeting a part of the definition identified above) may very well contribute to the height of the building above grade, if it is constructed according to one of the methods defined above.

Figures 2a through 2c illustrate conditions where a basement contributes to the number of stories above grade.

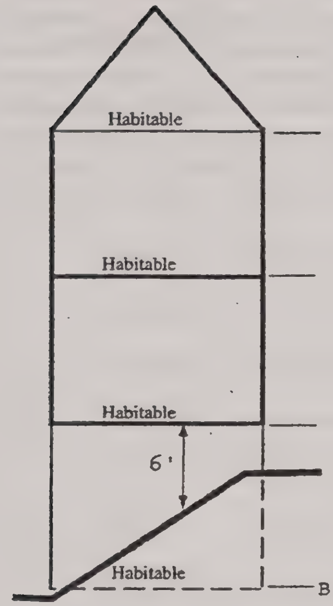


Figure 2a.

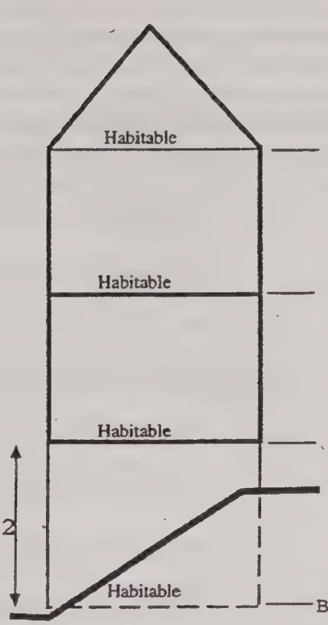


Figure2b.

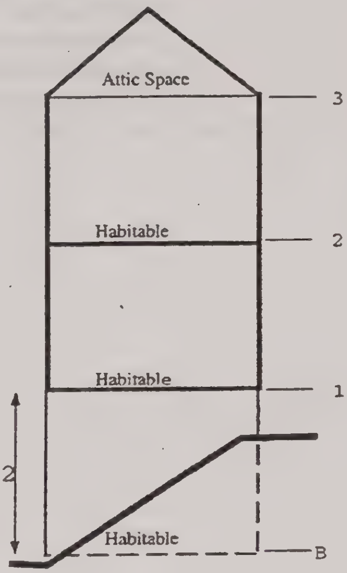


Figure2c.

Note: Both Figures 2a and 2b depict a single family dwelling which is **four stories** above grade (in reference to the definition for story above grade). Since the definition of an R-4 limits the building to **three stories** in height, these buildings (Figures 2a and 2b), erected of Type 5B construction, would be in violation of building code provisions. However, as is illustrated in Figure 2c, if the upper-most floor is designed and used as an attic (as defined in 780 CMR 202), it shall not be considered an additional story).

Question: To this point, only the height of the building has been addressed. What about the maximum area per floor for an R-4 structure?

Answer: Unlike the number of stories above grade, the code is silent on the issue of floor area for these structures. Essentially, the area is unlimited. This is not to imply that the code is not concerned with the size of the building in terms of its area, and that additional safeguards should not be considered in the design and construction of very large R-4 structures. However, these safeguards are built into the code in that very large buildings will be afforded additional smoke detection (see Chapter 36, Section 3603.16) and large structures are generally designed with egress capacity well in excess of what the code would normally require; usually with many exterior decks and balconies providing additional means of egress and/or routes of escape from the building.

Question: At the start of this interpretation, it was mentioned that Section 310.6 affords the code user two options when designing and building R-4 structures. We spoke of Chapter 36 requirements, but what about the option of designing the building as an R-3 using code provisions applicable to that use group?

Answer: It is clear that the code allows one to utilize this option. In doing so, however, one must recognize that different code requirements apply. Why? The Sixth Edition of 780 CMR is based on two separate national model codes; the 1993 BOCA National Building Code and the 1995 CABO One and Two Family Dwelling Code. As one might expect, uniting these two codes into a single document (as was done with the Sixth Edition of the Massachusetts State Code) sometimes results in conflicts between the two texts. The subject matter this interpretation illustrates one of these conflicts.

In explanation, R-3 structures are typically designed as multiple, single family, attached units (what are commonly referred to as row houses). Because these units are adjoined, the code is more concerned with conflagration and other safety issues, and therefore restricts the design of these structures more rigorously than it does for detached one and two-family dwellings.

We know that Chapter 36 is silent on height and area limitations for one and two family structures. Reviewing code provisions relative to R-3 structures, we find that 780 CMR Chapter 5, Table 503 defines height and area limitations for the R-3 Use Group Classification, but does not include reference to detached one and two-family buildings, as does the 1993 BOCA National Code. This reference was purposely deleted in the Massachusetts code to illustrate that the intended height limitations for detached one and two-family dwellings is to be three stories above grade as defined herein (and 780 CMR 310.6).

APPENDIX H

HISTORIC STRUCTURES

Historic structures eligible for individual listing in the National Register of Historic Places, qualifying as totally preserved buildings (see 780 CMR 3409.0).

Acton	Faulkner Homestead, High Street
Agawam	Capt. Charles Leonard House, Main Street
Amesbury	Rocky Hill Meetinghouse, Portsmouth Road
Arlington	Fowle-Reed-Wyman House, 64 Old Mystic Street Jason Russell, 7 Jason Street Old Schwamb Mill, 17 Mill Lane
Barre	Barre Historical Society, Common Street
Barnstable	Barnstable Custom House, Route 6A
Bedford	Job Lane House, 295 North Road
Beverly	John Balch House, 448 Cabot Street Capt. John Cabot House, 117 Cabot Street Rev. John Hale House, 39 Hale Street
Boston	Gleason House, Beacon Street James Blake House, E. Cottage Street (Dor.) Clapp Houses, 105 Boston Street (Dor.) Loring-Greenough House, 12 South Street (JP) Old State House, 15 State Street Pierce House, 24 Oakten Avenue (Dor.) South End Historical Soc., 532 Mass. Avenue Isabella Stewart Gardner Museum, 280 The Fenway
Boxford	Holyoke-French House, Elm Street Sylvanius-Thayer Birthplace, 786 Washington St
Brookline	Edward Devotion House, 347 Harvard Street
Burlington	Francis Wyman House, Francis Wyman Road
Cambridge	Cooper-Frost-Austin House, 21 Linnaean St.
Charlton	Ryder Tavern, Stafford Street
Chelmsford	Old Chelmsford Garrison House, 105 Garrison Road
Chelsea	Gov. Bellingham-Cary House, 34 Parker Street
Cohasset	Caleb Lothrop House, 14 Summer Street
Cummington	William Cullen Bryant Homestead, Bryant Road
Danvers	Fowler House, 166 High Street Rebecca Nurse House Glen Magna House
Dennis	Josiah Dennis Manse, Nobscuset Road West Schoolhouse

Duxbury	Gershom Bradford House, 931 Tremont Street
	King Caesar House, King Caesar Road
	Nathaniel Winsor House, 479 Washington Street
Gloucester	Beauport, Eastern Pt. Blvd.
	Hammond Castle, 80 Hesperus Avenue
Hadley	Hadley Farm Museum, Russell Street
	Porter Phelps Huntinghouse, 130 River Drive
Haverhill	The Whittier House, 305 Whittier Road
Holyoke	Wisteriahurst, 238 Cabot Street
Ipswich	Castle Hill, Argilla Road
Lee	Merrell Tavern, Route 102
Lenox	Ventfort Hall, 104 Walker Street
Lexington	Buckman Tavern, 1 Bedford Street
	Sanderson House, 314 Massachusetts Ave.
	Monroe Tavern, 1332 Massachusetts Ave.
Lincoln	The Grange, Codman Road
Lowell	Whistler House, Worthen Street
Lynnfield	Meetinghouse
Medford	Peak House, 347 Main Street
Milton	Dr. Amos Holbrook House, 203 Adams Street
	Daniel Vose House, 1370 Canton Avenue
Nantucket	Whaling Museum, Broad Street
	Fire Hose Cart House, 8 Gardner Street
	Greater Light, 8 Howard Court
	Old Gaol, 15 Vestal Street
	1800 House, 4 Mill Street
	Old Mill, 50 Prospect Street
	Hawden House, 96 Main Street
	Nathaniel Macy House, 12 Liberty Street
	Thomas Macy Warehouse, 10 Straight Wharf
	Fair Street Museum, 7 Fair Street
	Quaker Meeting House, 7 Fair Street
New Bedford	Benjamin Rodman House, 50 North Second Street
New Salem	Whitaker-Clary House, Elm Street
Newbury	Tristram Coffin House, 16 High Road
	Spencer-Pierce-Little House, Little Lane
Newton	Jackson Homestead, 527 Washington Street
No. Andover	Parson Barnard House, Osgood Street
No. Easton	Old Colony Railroad Station, Oliver Street
Norwood	Fred Holland Day, 93 Bay Street
Orleans	French Cable Station, Cove Road

Oxford	Clara Barton Homestead, Clara Barton Road
Peabody	Gen. Gideon Foster House, 35 Washington Street
Pittsfield	Herman melville House, 78 Holmes Road
Plymouth	Plymouth Antiquarian Society, 126 Water Street
	Harlow Old Ft. House, 19 Sandwich Street
	Pilgrim Hall, 75 Court Street
	Richard Sparrow House, 42 Summer Street
Quincy	Adams Academy, 8 Adams
	Quincy Homestead, 34 Butler Street
	Josiah Quincy House, 20 Muirhead Street
Randolph	Johnathan Belcher House, 360 N. Main
Reading	Parker Tavern, 103 Washington Street
Rockport	Old Castle, Castle Lane
Salem	House of 7 Gables, 46-54 Turner Street
	Essex Institute, Essex Street
	The Norbone House
	Witch Museum
	Crowningshield Bently, Essex Street
	Gardner-Pingree House, 128 Essex Street
	Gedney House, 21 High Street
	Cox House, 19 High Street
Sandwich	Hoxie House, 18 Water Street
	Eldred House, 4 Water Street
	Wing Fort House, Spring Hill Road
Sheffield	Col. John Ashley House, Cooper Hill Road
Shrewsbury	Gen. Artemas Ward Homestead, Main Street
Springfield	Alexander House, State Street
	George Walter Vincent Smith Art Museum
Stockbridge	Naumkeag, Prospect Hill
Swansea	The Luther Store, 160 Old Warren Road
	The Martin House, 22 Stoney Hill Road
Taunton	Old Colony Historical Society, 66 Church Green
	Parson Capen House
Waltham	Robert Treat Paine House, 577 Beaver Street
Watertown	Edmund Fowle House, 26 Marshall Street
Wenham	Claflin-Richard House, 132 Main
West Springfield	Josiah Day House, 70 Park Street
Weston	Gold Ball Tavern, Old Post Road
Woburn	Loammi Baldwin Mansion, 2 Alfred Street
Wilmington	Harden Tavern, 436 Salem Street

Worcester	Timothy Paine House, 140 Lincoln Street

National Historic Landmarks

Amesbury	John Greenleaf Whittier Home, 86 Friend Street
Boston	African Meeting House, 8 Smith Court Nichols House, 55 Mt. Vernon Street Brook Farm, 678 Baker Street (Rox.) Christ Church, 191 Salem Street Faneuil Hall, Dock Square 1st Harrison Gray Otis House, 141 Beacon Street Paul Revere House, 19 North Street
Concord	Ralph Waldo Emerson House, 28 Cambridge Tpk. The Old Manse Orchard House, 299 Lexington Road
Dedham	Fairbanks House
Deerfield	Old Deerfield Village Historic District
Hancock	Hancock Shaker Village
Harvard	Fruitlands, Prospect Street
Hingham	Old Ship Meetinghouse, Main Street
Ipswich	John Whipple House, 53 S. Main Street
Lexington	Hancock Clarke House, 35 Hancock Street
Marblehead	Jeremiah Lee House, Washington Street King Hooper Mansion, Hooper Street
Marshfield	Daniel Webster Law Office, Webster Street
Medford	Peter Tufts House, 350 Riverside Drive Isaac Royal House, 15 George Street
Milton	Capt. R. B. Forbes House, 215 Adams
Nantucket	Nantucket Historic District Jethro Coffin House, Sunset Hill
New Bedford	New Bedford Historic District
Newburyport	Caleb Cushing House, 98 High Street
Quincy	John Adams Birthplace, 133 Franklin Street John Quincy Adams Birthplace, 141 Franklin Street
Salem	Peabody Museum The Custom House, 178 Derby Street
Saugus	Scotch Boardman House, 117 Howard Street
Stockbridge	Chesterwood, Williamsville Road The Mission House, Main Street
Waltham	The Vale, Lyman Street

APPENDIX J

ENERGY CONSERVATION FOR NEW CONSTRUCTION LOW-RISE RESIDENTIAL BUILDINGS

(780 CMR Appendix J is based upon the Council of American Building Officials Model Energy Code 1995 Edition.)

780 CMR J1.0 ADMINISTRATION AND ENFORCEMENT

J1.1 Scope and General Requirements:

J1.1.1 Title: Appendix J reflects the technical requirements of the Model Energy Code 1995 Edition, but also contains material which reflects the unique requirements of Massachusetts.

J1.1.2 Scope: 780 CMR Appendix J sets forth minimum requirements for the design and construction of new residential occupancy buildings and additions to existing residential occupancy buildings three stories or less in height by regulating the design and construction of building envelopes for adequate thermal resistance and low air leakage, and by the design, selection, and installation of mechanical, electrical, and service water heating systems and equipment to enable efficient use of energy. It is intended that these provisions provide flexibility to permit the use of innovative approaches and techniques to achieve effective utilization of energy. 780 CMR Appendix J is not intended to abridge safety, health, or environmental requirements under other applicable code sections or ordinances.

Note: For alterations to existing buildings, see 780 CMR J1.1.2.3 and Chapter 34.

J1.1.2.1 Building Types:

J1.1.2.1.1 Group R residential buildings: New construction buildings, or new portions thereof, that must comply with the requirements of Appendix J are:

1. Detached one- and two-family dwellings (Use Groups R-4 or R-5 in 780 CMR 310); and,
2. All other residential buildings, three stories or less in height (Use Groups R-2, R-3, or R-5 in 780 CMR 310). Note that Use Group R-1 buildings are to be treated as *commercial buildings*.

J1.1.2.1.2 Other Buildings: New construction buildings and structures not included in 780 CMR J1.1.2.1.1. shall be classified as Commercial/High-Rise Buildings and shall be designed and constructed to comply with the requirements of 780 CMR 13.

J1.1.2.2 Exempt buildings: The following buildings or structures shall be exempt from the requirements of 780 CMR Appendix J:

1. Buildings and structures or portions thereof whose peak design rate of energy usage is less than 3.4 Btu/h per square foot (10.7 W/m^2) or 1.0 watt per square foot (10.7 W/m^2) of floor area for all purposes;
2. Greenhouses that are free-standing, or attached to a building and separated by a wall having the same thermal value as an exterior wall, and provided with a separate temperature control system;
3. Buildings with less than 100 square feet of gross floor area, and;
4. Buildings and structures or portions thereof which are neither heated nor cooled.

J1.1.2.3 Application to existing buildings:

J1.1.2.3.1 Additions to existing buildings: Additions to existing buildings or structures shall comply with one of the applicable criteria below:

1. The new addition, by itself, shall conform to the applicable provisions of Appendix J, **or;**
2. The new addition plus the existing building/dwelling unit may be considered together to ensure compliance with all applicable provisions of Appendix J, **or;**
3. Additions that are open to or separated by an exterior wall from the existing house/dwelling unit shall meet the prescriptive envelope component criteria of Table J1.1.2.3.1. The total area (rough opening or unit dimensions) of glazed fenestration products (windows, skylights, and glazed portion of doors) shall not exceed 40% of the gross wall and gross ceiling area of the addition combined. If any individual fenestration component exceeds the maximum U-value listed in Table J1.1.2.3.1, then the area-weighted average U-value for all fenestration components must be less than or equal to the listed value. The R-value requirements for opaque thermal envelope

components indicate insulation products (cavity and/or insulating sheathing), and shall be equal to or exceed the applicable listed values found in Table J1.1.2.3.1. If such additions are separated from the main house by a wall and are conditioned, then a readily accessible manual or automatic means shall be provided to partially restrict or shut off the heating and/or cooling input to the addition space. That portion of a wall that separates the addition from the existing building/dwelling unit, if an existing exterior wall, shall be allowed to remain and neither that portion of said wall or any fenestration within said portion of wall common to the addition need comply with the thermal envelope requirements of Appendix J.

TABLE J1.1.2.3.1
Prescriptive Envelope Component Criteria Additions to Existing Low-Rise Residential Buildings

MAXIMUM	MINIMUM				
Fenestration U-value	Ceiling R-Value	Wall R-Value	Floor R-Value	Basement Wall R-Value	Slab Perimeter R-Value and Depth
0.39	R-37[1]	R-13	R-19	R-10	R-10, 4 ft

[1] R-30 ceiling insulation may be used in place of R-37 if the insulation achieves the full R-value over the entire ceiling area (i.e. - not compressed over exterior walls, and including any access openings.)

Exception: *Sunroom* Additions / Consumer Notification: *Sunrooms*, as defined in 780 CMR Appendix J2.0 DEFINITIONS, shall be exempt from the compliance requirements set forth in 780 CMR J1.1.2.3.1 and J1.1.3 provided that the actual property owner (not the owner's agent or representative) of the structure onto which the *sunroom* addition is being made, provides a signed copy of the Sunroom "CONSUMER INFORMATION FORM" (found in 780 CMR, Appendix B) to the Building Department. This signed "CONSUMER INFORMATION FORM" shall be submitted to the building official as a requirement of building permit issuance, and shall remain as part of the construction documents. If such *sunroom* additions are separated from the main house by a wall and are conditioned spaces, then a readily accessible manual or automatic means shall be provided to partially restrict or shut off the heating and/or cooling input to the *sunroom* addition space. That portion of a wall that separates the *sunroom* addition from the existing building/dwelling unit, if an existing exterior wall, shall be allowed to remain and neither that portion of said wall or any fenestration within said portion and common to the *sunroom* addition, need comply with the thermal envelope requirements of Appendix J.

J1.1.2.3.2 Historic buildings: Historic buildings, as defined in 780 CMR 3409, are exempt from Appendix J.

J1.1.2.3.3 Change of occupancy: A change in the occupancy or change in use of an existing building or structure shall be permitted, subject to the provisions of 780 CMR 3407.

J1.1.2.4 Mixed occupancy: When a building houses more than one occupancy, each portion of the building shall conform to the requirements for the occupancy housed therein. Where minor accessory uses do not occupy more than 10% of the area of any floor of a building, the major use shall be considered the building occupancy.

J1.1.3 Compliance: Compliance with Appendix J shall be determined by one of the following alternatives:

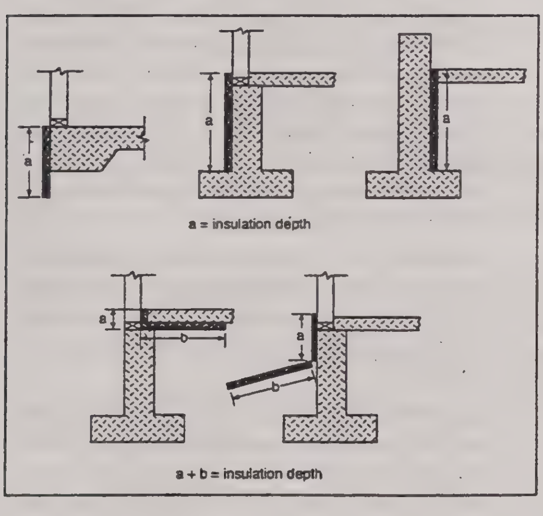
1. 780 CMR J5.0, Residential Building Design by Prescriptive Practice (or Default Package Approach) in which the U and R values are given for the thermal envelope. Additional requirements are stated in 780 CMR J4.0, or;
2. 780 CMR J6.0, Residential Building Design by Component Performance (or Manual Trade-off Approach) which allows trade-offs between building envelope components and heating and cooling equipment efficiencies to minimize cost. Additional requirements are stated in 780 CMR J4.0, or;
3. 780 CMR J7.0, Residential Building Design by MAS*check* Software which achieves similar results as the Manual Trade-off Approach. Additional requirements are stated in 780 CMR J4.0, or;
4. 780 CMR J8.0, the Systems Approach or Total Energy Analysis for the entire building and its energy using sub-systems, or;
5. 780 CMR J9.0, Buildings Utilizing Renewable Energy Resources.
6. 780 CMR J11.0, a Home Energy Rating issued for the home with a score of 83.0 or more points

J1.2 Construction Documents:

J1.2.1 General: Construction documents including necessary computations shall be submitted to the building official as part of the building permit application process. Such construction documents shall indicate conformance with 780 CMR J1.2 and other applicable sections of 780 CMR, and in accordance with 780 CMR 110.

J1.2.2 Details: The construction documents shall show in sufficient detail pertinent data and features of the building project and the equipment and systems as herein governed, including, but not limited to, design criteria, exterior envelope component materials, *U*-values of the envelope systems, *R*-values of insulating materials, size and type of apparatus and equipment, equipment and minimum distance of 24 inches (610 mm), or downward to at least the bottom of the slab and then horizontally to the interior or exterior for a minimum total distance of 24 inches (610 mm) and shall be an approved type. In climates equal to or greater than 6,000 annual Fahrenheit heating degree days (HDD_{65}), the insulation shall extend downward from the elevation of the top of the slab for a minimum of 48 inches (1219 mm), or downward to at least the bottom of the slab and then horizontally to the interior or exterior for a minimum total distance of 48 inches (1219 mm). In all climates, the horizontal insulation extending outside of the foundation shall be covered by pavement or by soil a minimum of ten inches (254 mm) thick. The top edge of the insulation installed between the exterior wall and the edge of the interior slab shall be permitted to be cut at a 45-degree angle away from the exterior wall. (see Figure J4.2.2.)

Figure J4.2.2
Typical Slab-on-grade Insulation Examples



J4.2.4 Crawl spaces: The floor above a crawl space shall be insulated to a minimum of R-19. See also 780 CMR 3603.6.8.2

J4.2.5 Access openings: Access doors, hatches, scuttles, pull down staircases and similar constructions that are part of the building envelope shall be insulated to a level equivalent to the insulation of the surrounding floor, wall, and ceiling.

> **Exception:** If the access opening has less insulation than the surrounding area, for calculation purposes the U-value of the surrounding floor, wall, and ceiling shall be increased accordingly.

J4.2.6 Masonry veneer: When insulation is placed on the exterior of a foundation supporting a masonry veneer exterior, the horizontal foundation surface supporting the veneer is not required to be insulated to satisfy the foundation insulation requirement.

J4.2.7 Return-Air Ceiling Plenums: When return-air ceiling plenums are employed, the roof/ceiling assembly shall:

1. For thermal transmittance purposes, not include the ceiling proper nor the plenum space as part of the assembly; and,
2. For gross area purposes, be based upon the interior face of the upper plenum surface.

780 CMR J4.3 Air leakage.

J4.3.1 The requirements of 780 CMR J4.3 shall apply to those locations separating outdoor ambient conditions or exempted portions of the building (e.g.- attics, unconditioned basements) from interior conditioned spaces.The requirements are not applicable to the separation of interior conditioned spaces from each other.

J4.3.2 Window and Door Assemblies: Exterior doors and windows shall be designed to limit air leakage into and from the building envelope. Manufactured doors and windows shall comply with the maximum allowable infiltration rates in Table J4.3.2.

> **Exception:** Site constructed windows and doors sealed in accordance with 780 CMR J4.3.3.

Table J4.3.2
Allowable Air Infiltration Rates[1]

Frame Type	Windows (cfm per ft of operable sash crack)	Doors (cfm per ft^2 of door area)	
Wood[2]	0.34	0.35[5]	0.5[6]
Alum[3]	0.37	0.37	0.5[6]
PVC[4]	0.37	0.37	0.5[6]

1. When tested in accordance with Standard ASTM E 283, as listed in Appendix A.
2. See Standard ANSI/NWWDA I.S.2, as listed in Appendix A.
3. See Standard ANSI/AAMA 101, as listed in Appendix A.
4. See Standards AAMA 101V and ASTM D 4099, each as listed in Appendix A.
5. Requirement based on door area specified in Standard ANSI/NWWDA I.S.3, as listed in Appendix A.
6. Requirement based on assembly area; except for manufactured (mobile) housing for which the requirement shall be 1.0 cfm/ft^2 (5.08 L/s/m^2) of door area; in accordance with Standard AAMA 1701.2 as listed in Appendix A.

J4.3.3 Joints, seams or penetrations in the building envelope that are sources of air leakage shall be sealed with durable caulking materials, closed with gasketing systems, taped or covered with moisture vapor permeable house-wrap per manufacturer's directions. Air leakage locations to be treated shall include openings, cracks and joints between framing members and window or door frames; between wall assemblies or their sill-plates and foundations; between walls and roof/ceilings or attic/ceiling seals and between separate wall panels; between walls and floor assemblies; penetrations of utility services through walls, floors and roof assemblies, penetration through the wall cavity of top and/or bottom plates; and all other such openings in the building envelope. Sealing materials shall be compatible with the construction materials, location, and anticipated conditions. Sealing materials spanning joints between dissimilar construction materials shall allow for differential expansion and contraction of the construction materials.

This includes sealing around tubs and showers, at the attic and crawl space access panels, at recessed lights and around all plumbing, electrical, and HVAC penetrations. These are openings located in the building envelope between conditioned space and unconditioned space or between the conditioned space and the outside.

J4.3.4 Recessed lighting fixtures: When installed in the building envelope, recessed lighting fixtures shall meet one of the following requirements:

1. Type IC rated, manufactured with no penetrations between the inside of the recessed fixture and ceiling cavity and sealed or gasketed to prevent air leakage into the unconditioned space.
2. Type IC rated, in accordance with Standard ASTM E 283, as listed in Appendix A, with no more than 2.0 cfm (0.944 L/s) air movement from the conditioned space to the ceiling cavity. The lighting fixture shall have been tested at 75 Pa or 1.57 lbs/ft.^{2} pressure difference and shall be labeled.

J4.4 Building Mechanical Systems

J4.4.1 General: 780 CMR J4.4 covers the determination of heating and cooling loads, design requirements, system and component performance control requirements, insulating systems and duct construction.

Note: 780 CMR J4.4 addresses, in depth, requirements for "simple" heating and cooling systems. "Simple" systems are characterized as those typically found in one-and two-family houses (such as standard design boilers, furnaces, air conditioners, or heat pumps that provide heating and/or cooling). 780 CMR J4.4 also covers requirements for more "complex" systems (such as those designed to deliver heating and cooling simultaneously, evaporative coolers, water chillers, and others,) but such "complex" systems are only cited in this section, with reference to the other sections of 780 CMR where detailed criteria are given.

J4.4.2 Calculation of heating and cooling loads:

J4.4.2.1 Calculation procedures: For the purpose of sizing HVAC systems, heating and cooling design loads shall be determined in accordance with techniques recommended in the ASHRAE Handbook of Fundamentals or the Air Conditioning Contractors Association's Manual "J", or other procedure approved by the Board of Building Regulations and Standards. The design parameters specified in 780 CMR J3.0 shall apply for all computations.

J4.4.2.1.1 System heating/cooling capacity: The rated output capacity of the heating/cooling system at design conditions shall not be greater than 125% of the design load calculated in accordance with this article. Equipment designed for standby purposes is not included in the capacity limitation requirement. For a single piece of equipment which has both heating and cooling capability, only one function, either the heating or the cooling, need meet the requirements of 780 CMR J4.4. Capacity for the other function shall be, within available equipment options, the smallest size necessary to meet the load.

Exception 1: If the rated output capacity of available equipment options exceeds 125% of the design load, then equipment with the smallest output capacity above 125% of the load shall be utilized.

Exception 2: Where the HVAC system for the building uses interconnected equipment designed to sequence with the load and it can be shown that such design will use less energy on an annual basis than one large unit.

J4.4.2.1.3 Simultaneous heating and cooling: See 780 CMR 1305.3.5.

J4.4.2.2 Infiltration: Infiltration for heating and cooling design loads shall be calculated for all buildings except one- and two-family dwellings by the procedures in Chapter 22 of the ASHRAE Handbook of Fundamentals. Calculations for one and two family dwellings may use the methods identified above or other accepted engineering practices.

J4.4.3 HVAC equipment performance requirements.

J4.4.3.1 Equipment and components:

TABLE J4.4.3.4d
PACKAGED TERMINAL AIR CONDITIONERS - AIR COOLED, ELECTRICALLY OPERATED STANDARD RATING CONDITIONS AND MINIMUM PERFORMANCE

REFERENCE STANDARD	CATEGORY PTAC's & PTAC HEAT PUMPS	SUB-CATEGORY & RATING CONDITIONS (Outdoor Temperature)[1]	EFFICIENCY RATING	MINIMUM PERFORMANCE[2]
ARI Standard 310, as listed in Appendix A	Cooling Mode	Standard Rating (95°F db)	EER	10.0 - (0.16 x Cap/1,000)
		Low Temperature Rating (82°F db)	EER	12.2 - (0.20 x Cap/1,000)

For SI: °F = 1.8°C + 32, 1 Btu/h = 0.2931 W.

[1] db = dry bulb.

[2] Capacity (Cap) means the rated cooling capacity of the product in Btu/h in accordance with the cited ARI Standard. If the unit's capacity is less than 7,000 Btu/h, use 7,000 Btu/h in the calculation. If the unit's capacity is greater than 15,000 Btu/h, use 15,000 Btu/h in the calculation.

TABLE J4.4.3.4e
ROOM AIR CONDITIONERS AND ROOM AIR CONDITIONER HEAT PUMPS STANDARD RATING CONDITIONS AND MINIMUM PERFORMANCE

REFERENCE STANDARDS	CATEGORY	MINIMUM PERFORMANCE[1]
ANSI/AHAM RAC-1-, as listed in Appendix A	Without Reverse Cycle and With Louvered Sides	
	<6,000 Btu/h	8.0 EER
	≥6,000 Btu/h and <8,000 Btu/h	8.5 EER
	≥8,000 Btu/h and <14,000 Btu/h	9.0 EER
	≥14,000 Btu/h and <20,000 Btu/h	8.8 EER
	≥20,000 Btu/h	8.2 EER
	Without Reverse Cycle and Without Louvered Sides	
	<6,000 Btu/h	8.0 EER
	≥6,000 Btu/h and <20,000 Btu/h	8.5 EER
	≥20,000 Btu/h	8.2 EER
	With Reverse Cycle and With Louvered Sides	8.5 EER
	With Reverse Cycle and Without Louvered Sides	8.0 EER

For SI: 1 Btu/h = 0.2931 W.

[1] To be consistent with National Appliance Energy Conservation Act of 1987 (Public Law 100-12).

TABLE J4.4.3.4f
LARGE UNITARY AIR CONDITIONERS AND HEAT PUMPS ELECTRICALLY-OPERATED >135,000 Btu/h COOLING CAPACITY STANDARD RATING CONDITIONS AND MINIMUM PERFORMANCE

REFERENCE STANDARDS	EFFICIENCY RATING	MINIMUM PERFORMANCE	
Air-Conditioners	EER	≤760,000 Btu/h: 8.5	>760,000 Btu/h: 8.2
Air Cooled ARI 360, as listed in Appendix A	IPLV	7.5	
Air-Conditioners	EER	9.6	
Water/Evap. Cooled CTI Standard 201, ARI 360, each as listed in Appendix A	IPLV	0.9	
Heat Pumps[1] Air Cooled-Cooling	EER	<760,000 Btu/h 8.5	≥760,000 Btu/h 8.2
ARI 340, as listed in Appendix A	IPLV	7.5	
Condensing Units[2]	EER	9.9	
Air Cooled ARI 365, as listed in Appendix A	IPLV	11.0	
Condensing Units[2]	EER	12.9	
Water/Evap. Cooled CTI Standard 201, ARI 365, each as listed in Appendix A	IPLV	12.9	

For SI: 1 Btu/h = 0.2931 W.

[1] For units that have a heating section, deduct 0.2 from all required EER's and IPLV's.

[2] Condensing unit requirements are based on single-number ratings defined in paragraph 5.1.3.2 of UL 731, as listed in Appendix A

J4.4.3.5 Mechanical Ventilation: Each mechanical ventilation system (supply and/ or exhaust) shall be equipped with a readily accessible switch or other means for shutoff or volume reduction and shutoff when venti-lation is not required. Automatic or gravity dampers that close when the system is not operating, or other acceptable method to prevent air leakage through ducts, shall be provided for outdoor air intake and exhausts.

J4.4.3.5.1 780 CMR J4.4.3.5 applies to, but is not limited to, unitary (central) cooling equipment (air cooled, water cooled and evaporatively cooled), the cooling mode of unitary (central) and packaged terminal heat pumps (air source and water source), and packaged terminal air conditioners and room air conditioners.

J4.4.3.6 Applied HVAC system components, electrically operated, cooling mode: See 780 CMR 1305.3.3c.

J4.4.4 Transport energy: See 780 CMR 1305.3.9.

J4.4.5 Balancing: The HVAC system design shall provide means for balancing air and water systems. In doing so, the considerations shall include, but not be limited to, dampers, temperature and pressure test connections and balance valves.

J4.4.6 Controls.

J4.4.6.1 Temperature control: Each system shall be provided with at least one adjustable thermostat for the regulation of temperature. Each thermostat shall be capable of being set by adjustment or selection of sensors as follows:

J4.4.6.1.1 When used to control heating only: 55 to 75°F (12.8 to 23.9°C).

J4.4.6.1.2 When used to control cooling only: 70 to 85°F (21.1 to 29.4°C).

J4.4.6.1.3 When used to control both heating and cooling, it shall be capable of being set from 55 to 85°F (12.8 to 29.4°C) and shall be capable of operating the system heating and cooling in sequence. The thermostat and/or control system shall have an adjustable deadband of 10°F (5.6°C) or more.

J4.4.6.2 Humidity control: See 780 CMR 1305.2.4.2, 1305.3.4.5, and 1305.3.4.6.

J4.4.6.3 Zoning for temperature control.

J4.4.6.3.1 One and two family dwellings: At least one thermostat for regulation of space temperature shall be provided for each separate HVAC system. In addition, a readily accessible manual or automatic means shall be provided to partially restrict or shut off the heating and/or cooling input to each zone or floor.

J4.4.6.3.2 Multifamily dwellings three stories or less in height: For multifamily dwellings, each individual dwelling unit shall have at least one thermostat for regulation of space temperature. A readily accessible manual or automatic means shall be provided to partially restrict or shut off the heating and/or cooling input to each room. For spaces other than living units at least one thermostat for regulation of space temperature shall be provided for:

1. Each separate system.
2. Each separate zone as defined in 780 CMR J2. As a minimum, each floor of a building shall be consid-ered as a separate zone. In a multi-story building where the perimeter system offsets only the transmission losses of the exterior wall, an entire side of uniform exposure may be zoned separately. A readily accessible manual or automatic means shall be provided to partially restrict or shut off the heating and/or cooling input to each floor.

J4.4.6.3.3 Control setback and shutoff: The thermostat required in 780 CMR J4.4.6.3.1 and J4.4.6.3.2 or an alternate means, including, but not limited to, a switch or a clock, shall provide a readily accessible manual or automatic means for reducing the energy required for heating and cooling during periods of non-use or reduced need including, but not limited to, unoccupied periods and sleeping hours. Lowering thermostat set points to reduce energy consumption of heating systems shall not cause energy to be expended to reach the reduced setting.

J4.4.7 Air-handling duct system insulation: Ducts, plenums, and enclosures installed in or on buildings shall be thermally insulated as follows:

J4.4.7.1 Duct systems, or portions thereof, shall be insulated to provide thermal resistance, as specified in Table J4.4.7.1.

Exceptions: Duct insulation, except as required to prevent condensation, is not required in the following cases:

1. When supply- or return-air ducts are installed in basements or cellars having insulated walls.
2. When the heat gain or loss of the ducts, without insulation, will not increase the energy requirements of the building.
3. Within HVAC equipment.
4. Exhaust air ducts.

TABLE J4.4.7.1
MINIMUM DUCT INSULATION[1]

	COOLING[2]		HEATING[3]	
Duct location	Annual Cooling Degree Days base 65°F CDD	Insulation *R*-Value[7] (h·ft^2·°F)/Btu	Annual Heating Degree Days base 65°F	Insulation *R*-Value[7] (h·ft^2·°F)/Btu
Exterior of building	below 500	3.3	4,501 to 7,500	6.5
	500 to 1,150	5.0	above 7,500	8.0
Inside of building envelope or in unconditioned spaces[4]				
TD[5]≤15	—	Not Required	—	Not Required
40≥TD[5]>15	—	3.3	—	3.3
TD[5]>40	—	5.0[6]	—	5.0[6]

For SI: °F = 1.8°C + 32, 1 (h·ft^2·°F)/Btu = 0.176 m^2·k/W, 1 ft = 304.5 mm.

1. Insulation *R*-values shown are for the insulation as installed and do not include film resistance. The required minimum thicknesses do not consider water vapor transmission and condensation. Where control of condensation is required, additional insulation, vapor retarders, or both, shall be provided to limit vapor transmission and condensation. For ducts which are designed to convey both heated and cooled air, duct insulation shall be as required by the most restrictive condition. Where exterior walls are used as plenum walls, wall insulation shall be as required by the most restrictive condition of 780 CMR J4.4.7.
2. Cooling ducts are those designed to convey mechanically cooled air or return ducts in such systems.
3. Heating ducts are those designed to convey mechanically heated air or return ducts in such systems.
4. Unconditioned spaces include basements, crawl spaces, and attics.
5. TD is defined as the temperature difference at design conditions between the space within which the duct is located and the design air temperature in the duct.
6. Insulation resistance for runouts to terminal devices less than ten feet in length is not required to exceed an R-value of R-3.3. [(h·ft^2·°F)/Btu.]
7. Insulation resistance measured on a horizontal plane in accordance with ASTM C 518-85; Test Method for Steady State Heat Flux Measurements and Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus, at a mean temperature of 75°F at the installed thickness.

J4.4.8 Duct construction: As applicable, ductwork shall be constructed and erected in accordance with:

ACCA Manual D;
BOCA National Mechanical Code;
ASHRAE Handbook HVAC Systems and Equipment;
SMACNA, Installation Standards for Residential Heating and Air Conditioning Systems;
SMACNA, HVAC Duct Construction Standards - Metal and Flexible;
SMACNA Fibrous Glass Duct Construction Standards;
ASHRAE HVAC Applications Handbook;
NAIMA Fibrous Glass Duct Construction Standards, each as listed in Appendix A.

J4.4.8.1 High-pressure and medium-pressure ducts: See 780 CMR 1305.3.13.2.

J4.4.8.2 Duct sealing: The accessible joints, seams, and connections of all low-pressure supply and return ductwork that is located outside conditioned space, including stud bays or joist cavities/spaces used to transport air, shall be sealed using mastic with fibrous backing tape installed in accordance with the manufacturer's installation instructions. Other sealants may be approved by the Board of Building Regulations and Standards. For fibrous ducts, pressure sensitive tape may be used if installed in accordance with NAIMA Fibrous Glass Duct Construction Standards, as listed in Appendix A. Duct tape is not permitted as a sealant on any ducts.

Exception 1: Fibrous backing tape need not be used in the following cases:

1. On duct connections which are overlapped.
2. Where gaps are less than 1/8" in any dimension.
3. On flex duct connections with properly installed tension straps.

Exception 2: Lengthwise snap-lock joints on round or rectangular ducts need not be sealed if they are tight fitting.

J4.4.9 Piping insulation: Piping installed for space conditioning shall be thermally insulated in accordance with Table J4.4.9. For service water-heating systems, see 780 CMR J4.5.

Exceptions: Piping insulation is not required in the following cases:

1. Piping installed within HVAC equipment.
2. Piping at fluid temperatures between 55°F and 120°F (12.7°C and 48.9°C) when not required for energy conservation purposes.
3. When the heat loss and/or heat gain of the piping without insulation does not increase the energy requirement of the building.
4. When piping is installed in basements or cellars having insulated walls in one and two family dwellings.

TABLE J4.4.9
MINIMUM PIPE INSULATION[1] (Thickness in Inches)

PIPING SYSTEM TYPES	FLUID TEMPERATURE RANGE, °F	Pipe Sizes					
		Run Outs 2"[2]	1" and Less	1¼" to 2"	2½" to 4"	5" to 6"	8" and Larger
HEATING SYSTEMS Steam and hot water High pressure/temp	306-450	1½	2½	2½	3	3½	3½
Med. pressure/temp	251-305	1½	2	2½	2½	3	3
Low pressure/temp	201-250	1	1½	1½	2	2	2
Low temperature	120-200	½	1	1	1½	1½	1½
Steam condensate (for feed water)	Any	1	1	1½	2	2	2
COOLING SYSTEMS Chilled water,	40-55	½	½	¾	1	1	1
Refrigerant, or brine	below 40	1	1	1½	1½	1½	1½

For SI: 1 inch = 25.4 mm, °F = 1.8°C + 32, 1 ft = 304.8 mm.

1. For piping exposed to outdoor air, increase insulation thickness by ½ inch.
2. Runouts not exceeding 12 feet in length to individual terminal units.

J4.4.9.1 Other insulation thicknesses: Insulation thicknesses in Table J4.4.9 are based on insulation having thermal resistivity in the range of 4.0 to 4.6 h·ft^{2}·°F/Btu per inch (0.704 to 0.810 m^{2}·k/W per 25 mm) of thickness on a flat surface at a mean temperature of 75°F (24°C).

Minimum insulation thickness shall be increased for materials having values less than 4.0, or may be reduced for materials having values greater than 4.6 as follows.

For materials with thermal resistively greater than 4.6, the minimum insulation thickness may be reduced as follows:

$$\frac{4.6 \text{ x Table 503.9 Thickness}}{\text{Actual Resistivity}} = \text{New Minimum Thickness}$$

For materials with thermal resistively less than 4.0, the minimum insulation thickness shall be increased as follows:

$$\frac{4.0 \text{ x Table 503.9 Thickness}}{\text{Actual Resistivity}} = \text{New Minimum Thickness}$$

J4.5 Service Water Heating

J4.5.1 Scope: The purpose of 780 CMR J4.5 is to provide criteria for design and equipment selection that will produce energy savings when applied to service water heating. Water supplies to ice making machines, refrigerators, and toilets shall be taken from a cold-water line of the water distribution system.

J4.5.2 Water heaters, storage tanks and boilers.

J4.5.2.1 Performance efficiency: Water heaters and hot water storage tanks shall meet the minimum performance of water heating equipment specified in Table J4.5.2. Where multiple criteria are listed, all criteria shall be met.

Excption: Storage water heaters. Storage water heaters and hot water storage tanks having more than 140 gallons (530L) of storage capacity need not meet the standby loss (*SL*) or heat loss (*HL*) requirements of table J4.5.2 if the tank surface area is thermally insulated to *R*-12.5 and if a standing pilot light is not used.

J4.5.2.2 Insulation: Heat loss from unfired hot-water storage tanks shall be limited to a maximum of 6.5 Btu/h/ft.^{2} (20.5 W/m^{2}) of external tank surface area, based on 80°F (176°C) water-air temperature difference.

Exception: Unfired hot water storage tanks having more than 500 gallons (1893 L) of storage capacity thermally insulated to *R*-12.5.

J4.5.2.3 Combination service water heating/ space heating boilers: Service water-heating equipment shall not be dependent on year-round operation of space heating boilers; that is, boilers that have as another function winter space heating.

Exceptions:

1. Systems for which the input rating of the combined system is less than 150,000 Btu.
2. Systems for which the combined system capacity (input rating or storage volume) is less than twice that of the smaller of the separate heaters required in a system with separate space and water heating.
3. Systems with service/space heating boilers having a standby loss (Btu/h) (W) less than:

$$\frac{13.3\ pmd\ 400}{n}$$

determined by the fixture count method where:

pmd =probable maximum demand in gallons/hour as determined in accordance with Chapter 37 of the ASHRAE HVAC Systems and Applications Handbook, as listed in Appendix A.

n =fraction of year when outdoor daily mean temperature exceeds 64.9°F (18.3°C)

The standby loss is to be determined for a test period of 24 hour duration while maintaining a boiler water temperature of 90°F (32.2°C) above an ambient of 60 to 90°F (15.6 to 32.2°C) and a five-foot (1524 mm) stack on appliance.

TABLE J4.5.2
MINIMUM PERFORMANCE OF WATER HEATING EQUIPMENT

CATEGORY	TYPE	FUEL	INPUT RATING	V_T[1]	INPUT TO V, RATIO (Btu/h/gal)	TEST METHOD	ENERGY FACTOR[3]	THERMAL EFFICIENCY E_T%	STANDBY LOSS %/hr[7]
NAECA Covered Water Heating Equipment[4]	all	electric	$\le$12 kW	all[6]		Code of Federal Regulations, 10 CFR Part 430 Subpart B, Appendix E	$\ge 0.93-0.00132V$		
	storage	gas	$\le$75,000 Btuh	all[6]			$\ge 0.62-0.0019V$		
	instantaneous	gas	$\le$200,000 Btuh[6]	all			$\ge 0.62-0.0019V$		
	storage	oil	$\le$105,000 Btuh	all			$\ge 0.59-0.0019V$		
	instantaneous	oil	$\le$210,000 Btuh	all			$\ge 0.59-0.0019V$		
pool heater		gal/oil	all	all		ANSI Z21.56, as listed in Appendix A		$\ge$78%	
Other Water Heating Equipment[5]	storage	electric	all	all		ANSI Z21.10.3, as listed in Appendix A			$\le 0.30+27/V_T$
			$\ge$155,000 Btuh	all					
	storage/ instantaneous	gas/oil	>155,000 Btuh	all	<4,000			$\ge$78%	$\le 1.3+114/V_T$
				<10	<4,000			$\ge$78%	$\le 1.3+95/V_T$
				$\ge$10	$\ge$4,000			$\ge$80%	—
					$\ge$4,000			$\ge$77%	$\le 2.3+67/V_T$
Unfired Storage Tanks				all					$\le$6.5 Btuh/ square foot[8]

For SI: 1 Btuh/ft.^{2} = 3.155 W/m^2, 1 Btuh = 0.2931 W, 1 gallon = 3.785 L, °F. = 1.8°C + 32.

1. V_T is the storage volume in gallons as measured during the standby loss test. For the purpose of estimating the standby loss requirement using the rated volume shown on the rating plate, V_T should be no less than $0.95V$ for gas and oil water heaters and no less than $0.90V$ for electric water heaters.

3. V is rated storage volume in gallons as specified by the manufacturer.

4. Consistent with National Appliance Energy Conservation Act (NAECA) of 1987.

5. All except those water heaters covered by NAECA.

6. Code of Federal Regulations, 10 CFR Part 430 Subpart B, Appendix E, as listed in Appendix A, applies to electric and gas storage water heaters with rated volumes 20 gallons and gas instantaneous water heaters with input ratings of 50,000 to 200,000 Btuh.

7. When testing an electric storage water heater for standby loss using the test procedure of Section 2.9 of ANSI Z21.10.3-1990 Gas Water Heaters, Volume III, Circulating Tank, Instantaneous and Large Automatic Storage-Type Water Heaters, the electrical supply voltage shall be maintained within ±1% of the center of the voltage range specified on the voltage range specified on the water heater nameplate. Also, when needed for calculations, the thermal efficiency (Et) shall be 98%.

When testing an oil water heater using the test procedures of Section 2.8 and 2.9 of ANSI Z21.10.3, as listed in Appendix A, the following modifications will be made:

A vertical length of flue pipe shall be connected to the flue gas outlet of sufficient height to establish the minimum draft specified in the manufacturer's installation instructions. All measurements of oil consumption will be taken by instruments with an accuracy of ±1% or better.

The burner rate shall be adjusted to achieve an hourly Btu input rate within ±2% of the manufacturer's specified input rate with the CO_2 reading as specified by the manufacturer with smoke no greater than 1 and the fuel pump pressure within ±1% of the manufacturer's specification.

8. Heat loss of tank surface area (Btuh/ft.^{2}) based on 80°F. water-air temperature difference.

J4.5.3 Automatic controls: Service water-heating systems shall be equipped with automatic temperature controls capable of adjustment from the lowest to the highest acceptable temperature settings for the intended use. Temperature setting range shall be in accordance with Table 2 in Chapter 37 of ASHRAE HVAC Systems and Applications Handbook, as listed in Appendix A.

J4.5.4 Shutdown: A separate switch shall be provided to permit turning off the energy supplied to electric service water-heating systems. A separate valve shall be provided to permit turning off the energy supplied to the main burner(s) of all other types of service water-heating systems.

J4.5.5 Pump operation: Circulating hot-water systems shall be arranged so that the circulation pump(s) can be conveniently turned off, automatically or manually, when the hot-water system is not in operation.

J4.5.6 Pipe insulation: For re-circulating systems, piping heat loss shall be limited to a maximum of 17.5 Btu/h per linear foot (5.13 W per m^2) of pipe in accordance with Table J4.5.6, which is based on design external temperature no lower than 65°F (18.3°C). Other design temperatures must be calculated.

Exception: Piping insulation is not required when the heat loss of the piping, without insulation, does not increase the annual energy requirements of the building.

TABLE J4.5.6
MINIMUM PIPE INSULATION
(Thickness in Inches)

SERVICE WATER HEATING	PIPE SIZES[1]			
	Noncirculating Runouts	Circulating Mains and Runouts		
TEMPERATURES °F	Up to 1"	Up to 1¼"	1½" to 2"	Over 2"
170-180	0.5	1.0	1.5	2.0
140-160	0.5	0.5	1.0	1.5
100-130	0.5	0.5	0.5	1.0

For SI: 1 inch = 25.4 mm, °F = 1.8°C + 32.

1. Nominal iron pipe size and insulation thickness. Conductivity K ≈ 0.27

J4.5.7 Swimming pools.

J4.5.7.1 All pool heaters shall be equipped with an ON-OFF switch mounted for easy access to allow shutting off the operation of the heater without adjusting the thermostat setting and to allow restarting without re-lighting the pilot light.

J4.5.7.2 Pool covers: Heated swimming pools shall be equipped with a pool cover.

Exception: Outdoor pools deriving over 20% of the energy for heating from renewable sources (computed over an operating season) are exempt from this requirement.

J4.5.7.3 Time clocks: Time clocks shall be installed so that the pump can be set to run in the off-peak electric demand period and can be set for the minimum time necessary to maintain the water in a clear and sanitary condition in keeping with applicable health standard.

J4.5.8 Conservation of hot water.

J4.5.8.1 Showers: Shower heads shall have a maximum flow rate of 2.5 gallons per minute (gpm) (0.158 L/s) at a pressure of 80 pounds per square inch (psi) (551 kPa) when tested in accordance with ASME A112.18.1, as listed in Appendix A.

J4.6 Electrical Power and Lighting.

J4.6.1 Electrical energy consumption: In multifamily dwellings, provisions shall be made to determine the electrical energy consumed by each tenant by separately metering individual dwelling units.

Exception: Motels, hotels, college dormitories and other transient facilities.

J4.6.2 Lighting power budget: The lighting system shall meet the applicable provisions of 780 CMR 1308.

Exception: One-and Two-Family dwellings and the dwelling portion of multifamily residential buildings.

780 CMR J5.0 RESIDENTIAL BUILDING DESIGN BY PRESCRIPTIVE PACKAGE

(Also see 780 CMR J1.1.3)
Compliance Approach #1

Notes:

1. The Prescriptive Package Approach is expectedly the most conservative for building envelope compliance. It does not require calculation of a building's thermal performance, but allows the user to simply select a set of components from a pre-determined group after establishing the weather site and glazing area of the building.
2. There is no interpolation or extrapolation allowed between packages in Table J5.2.1b.
3. The Prescriptive Package Approach (780 CMR J5.0) is intended for one and two-family detached buildings heated with fossil fuels and having glazing representing no more than 18% of the gross wall area. Also, such buildings must be either wood frame or mass wall construction (concrete, masonry, log): metal frame buildings are excluded.
4. For one and two-family buildings that do not meet the requirements in Note 3, and for all multi-family buildings, refer to 780 CMR J1.1.3. compliance alternatives 2. through 5.
5. Table J5.2.1b is based on a number of assumptions about the buildings it covers. These assumptions are stated fully in the Footnotes to that table, and should be reviewed to assure that the Table is suitable for use with any given proposed building.

J5.1 Scope.

J5.1.1 General: Buildings constructed to 780 CMR J5.0 that are heated and/or mechanically cooled shall meet the applicable requirements of 780 CMR J5.0 and 780 CMR J4.0.

J5.2 Exterior Envelope Requirements

J5.2.1 General: The various building assemblies (window, wall, ceiling, floor, etc.) shall conform to the thermal transmittance and resistance values in Table J5.2.1b.

J9.0 Renewable Energy Source Analysis

J9.1 General: A proposed building utilizing solar, geothermal, wind or other renewable energy sources for all or part of its energy source shall meet the requirements of 780 CMR J8.0, except such renewable energy may be excluded from the total annual energy consumption allowed for the building by 780 CMR J8.0.

J9.1.1 To qualify for this exclusion, such renewable energy must be derived from a specific collection, storage, and distribution system. The solar energy passing through windows shall also be considered as qualifying if such windows are provided with:

- Operable insulation shutters or other devices which, when drawn or closed, shall cause the window area to reduce maximum outward heat flows to those in accordance with 780 CMR J4.3.2.

J9.1.2 Exclusion shall be granted for solar energy passing through windows provided:

1. The glass is double or triple pane insulating glass with a low emittance coating on one or more air space surfaces of the glass, or insulating glass with a low-emittance plastic film suspended in the air space, and
2. The glass areas are shaded from direct solar radiation during periods when mechanical cooling is requested.

J9.1.3 Other criteria covered in 780 CMR J8.0 shall apply to the proposed alternative designs utilizing renewable energy sources of energy.

J9.2 Documentation: Proposed alternative designs submitted as requests for exception to the standard design criteria shall be accompanied by an energy analysis, as specified in 780 CMR J8.0. The report shall provide technical detail on the alternative building and systems designs and on the data employed in and resulting from the comparative analysis as to verify that both the analysis and the designs meet criteria of 780 CMR J8.0.

The energy derived from renewable sources and the reduction in conventional energy requirements derived from nocturnal cooling shall be separately identified from the overall building energy use. Supporting documentation on the basis of performance estimates for the aforementioned renewable energy sources or nocturnal cooling means must be submitted.

Exception: Proposed alternative designs for residential buildings of less than 20,000 square feet (1858 m^2) that derive a minimum of 30% of their total annual energy usage from renewable energy sources or from nocturnal cooling shall be exempt from the requirement of a full-year energy system analysis, providing that the annual input of such renewable sources or the extent of such nocturnal cooling can be expected to meet the demands imposed by the proposed alternative design.

780 CMR J10.0 VALIDITY

If a section, subsection, sentence, clause or phrase of Appendix J is, for any reason, held to be unconstitutional, such section shall not affect the validity of the remaining portions of 780 CMR.

J11.0 Home Energy Rating

J11.1 General: A proposed building, for which the builder or the buyer obtains a Home Energy Rating by an accredited Home Energy Rating System (HERS), will be considered to comply with the intent of Appendix J if the rating score on the building is 83.0 or more points.

J11.1.1 Accreditation: Accreditation of the rating organization or agency with the Residential Energy Services Network (RESNET) or the Massachusetts Division of Energy Resources is required for acceptance of the energy rating as a compliance tool for *Appendix J*.

J11.1.2 Rating Score: The minimum compliance score of 83 points will be based on the national HERS Council's guidelines for Home Energy Ratings, and the rating score shall be determined with an acceptable software analysis program as required by RESNET accreditation procedures, on a scale of 0-100 points.

J11.2 Documentation: Compliance report which includes a proposed Energy Rating score of 83.0 or more points, a description of the building's energy features, and a statement that the rating score is "based on plans" will be required for issuance of a building permit. A copy of the final rating certificate indicating the score of 83.0 or more points for the finished building will be submitted to the building official before the Certificate of Occupancy is issued.

APPENDIX J REFERENCED STANDARDS	
Standard Reference Number	**Where Referenced in Appendix J (by Section Number)**
ACCA Manual D	J4.4.8
ANSI/ASME PTC 4.1	Table J4.4.3.2a
ANSI/AHAM RAC-1	Table J4.4.3.4e
ANSI Z21.10.3	J4.5.2
ANSI Z21.47	Table J4.4.2.2c
ANSI Z21.56	J4.5.2
ANZI Z21.13	Tables J4.4.3.2a; J4.4.3.3b
ANZI Z83.8	Table J4.4.3.2b
ANZI Z83.9	Table J4.4.3.2b
ASHRAE HVAC Applications Handbook	J4.4.8
ASHRAE Handbook HVAC Systems and Equipment	J4.4.8
ASHRAE 55	J2.0
ASTM E 779	J8.2.1.1
ARI 210/240	Tables J4.4.3.3a; J4.4.3.4a-d
ARI 320	Tables J4.4.3.3c; J4.4.3.4c
ARI 325	Tables J4.4.3.3d; J4.4.3.4d
ARI 340	Tables J4.4.3.3d; J4.4.3.4f
ARI 360	Table J4.4.3.4f (also see 780 CMR 13, Table 1311.6)
ARI 365	Table J4.4.3.4f
ARI 380	J2.0; Table J4.4.3.3b
ARI 550	Table J4.4.3.4f (also see 780 CMR 13, Table 1311.6)
CTI Standard 201	Tables J4.4.3.4b,c and f (also see 780 CMR 13, Table 1311.6)
Code of Federal Regulations, 10 CFR Part 430, Subpart B, Test Procedures	J2.0; Tables J4.4.3.2a and c; Table J4.5.2
NAIMA Fibrous Glass Duct Construction Standards	J4.4.8
SMACNA Duct Construction Standards, Metal and Flexible	J4.4.8
SMACNA Fibrous Glass Duct Construction Standards	J4.4.8
UL 726	Table J4.4.3.2a
UL 727	Table J4.4.3.2c
UL 731	Tables J4.4.3.2b; J4.4.3.4f
UL 795	Table J4.4.3.2a

ACCA	Air Conditioning Contractors of America, Washington, DC
ANSI	American National Standards Institute, Inc.., New York, NY
ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc., Atlanta, GA
ASTM	American Society for Testing and Materials, Philadelphia, PA
ARI	Air Conditioning and Refrigeration Institute, Arlington, VA
CTI	Cooling Tower Institute, Houston, TX
NAIMA	North American Insulation Manufacturers Association, Alexandria, VA
SMACNA	Sheet Metal and Air Conditioning Contractors National Association, Inc., Chantilly, VA
UL	Underwriters Laboratories, Northbrook, IL

negotiates, places, assists in placement, finds or offers to negotiate, place, assist in placement of mortgage loans on residential property for others, or as otherwise defined in M.G.L. c. 255E.

Mortgage lender: Any person engaged in the business of making mortgage loans, or issuing commitments to fund mortgage loans, or accepting applications or fees associated with the making of mortgage loans which are secured by a mortgage on residential property, or as otherwise defined in M.G.L. c. 255E.

Mortgage loan: A loan to any person made primarily for personal, family, or household purposes, secured wholly or partially by a mortgage on a residential property, or as otherwise defined by M.G.L c. 255E.

Owner: Any homeowner of a building which is an existing building at the time of a contract that is owner occupied, containing at least one but not more than four dwelling units, or a tenant authorized by the homeowner thereof, who orders, contracts for, or purchases the services of a contractor or subcontractor. An owner occupying a condominium unit in a building containing no more than four dwelling units qualifies as an owner under this definition, provided the owner owns a total of not more than four condominium units. A condominium association does not qualify as an owner.

Owner-occupied: The residential building of at least one but not more than four dwelling units and occupied by the owner as a primary residence.

Permit: For the purposes of 780 CMR R6, any construction-related permit, excluding any permits required by the owner which are not considered construction-related, such as zoning, environmental, historical commission, and the like.

Person: Any individual, partnership, corporation, society, trust, association, or any other legal entity.

Registrant: Any duly registered home improvement contractor or subcontractor.

Registration number: The number assigned to the applicant after he has been approved for registration by the director and the Board of Building Regulations and Standards.

Residential contracting: The reconstruction, alteration, renovation, repair, modernization, conversion, improvement, removal or demolition or the construction of an addition to any pre-existing owner-occupied building containing at least one but not more than four dwelling units, which building or portion thereof is used or designed to be used as a residence or dwelling unit, or to structures which are adjacent and accessory to such residence or building, including but not necessarily limited to: garages, sheds, cabanas, poolhouses, gazebos.

Salesperson: any person, other than a supplier of materials or a laborer, who solicits, offers, negotiates, executes, or otherwise endeavors to procure by any means whatsoever, directly or indirectly, a contract for residential contracting services from an owner on behalf of a home improvement contractor or subcontractor.

Secretary: The secretary of the Office of Consumer Affairs and Business Regulations.

Subcontract: A contract, written or verbal, in any amount, between a home improvement contractor and a subcontractor or between two subcontractors for the performance of any part of the home improvement contractor's or subcontractor's contract.

Subcontractor: Any person, other than a supplier of only materials, who enters into a contract, written or verbal, with a home improvement contractor for the performance of any part of a home improvement contractor's contract with an owner for residential contracting, or who enters into a contract with any other subcontractor for the performance of any part of the subcontractor's contract.

R6.1.3 Scope:

R6.1.3.1 M.G.L. c. 142A and 780 CMR R6 require the registration of persons who engage in residential contracting work as defined in 780 CMR R6 and M.G.L. c. 142A after July 1, 1992, and define the requirements of M.G.L. c. 142A and enforcement of these requirements, as they pertain to home improvement contractors and subcontractors.

R6.1.3.2 Except for those persons who are specifically exempt from the provisions of 780 CMR R6 and M.G.L. c. 142A, all contractors and subcontractors who engage in residential contracting as defined in 780 CMR R6 and M.G.L. c. 142A shall be subject to and shall comply with 780 CMR R6 and M.G.L. c. 142A.

R6.1.4 Administration and Enforcement:

R6.1.4.1 Director responsibility: The director shall promulgate and enforce the provisions of 780 CMR R6 and M.G.L. c. 142A as to all home improvement contractors and subcontractors who are registered or required to register.

R6.1.4.2 Advisory board: The director may appoint an advisory board which may review proposed suspensions, revocations, and administrative penalties against any registrants, and shall make recommendations to the director relative thereto. The advisory board shall include six members, any four of whom will constitute a quorum; the fund administrator, a representative of the attorney general, a representative of a consumer group appointed by the secretary, a representative of the Massachusetts Homebuilders Association who is a registered home improvement contractor or subcontractor, a Representative of the National Association of the Remodeling Industry, and a BBRS staff member.

R6.1.5 Persons Who Must Register:

R6.1.5.1 General: All home improvement contractors and subcontractors, as defined in 780 CMR R6, except those exempt in 780 CMR R6.1.6, shall register with the director by filing an application prescribed by the director.

R6.1.5.2 Designated individual: In the case of registration by a corporation or partnership, an individual shall be designated to be responsible for the corporation's or partnership's residential contracting work.

R6.1.5.3 Liability: The corporation or partnership and its designee shall be jointly and severally liable for the payment of the registration fee, the payment to the guaranty fund, and for violations of any provisions of 780 CMR R6, including actions by the registrant's employees, subcontractors or salespersons.

R6.1.6 Persons Exempt From Registration or Renewal: Any person exempt from registration under 780 CMR R6.1.6, and does not voluntarily register, is not subject to any of the provisions of 780 CMR R6 or M.G.L. c. 142A. Persons exempt from registration are:

1. the Commonwealth or its political subdivisions;
2. any school, public or private, offering as part of a vocational education program courses and training in any aspects of home construction or home improvements;
3. electricians, plumbers, architects or any other persons who are required by law to attain standards of competency or experience as a prerequisite to licensure for and engaging in such trade or profession and who are acting exclusively within the scope of the profession for which they are currently licensed pursuant to such law, *construction supervisors excepted.*
4. persons dealing in the sale of goods or materials who neither arrange to perform nor perform directly or indirectly any work or labor in connection with the installation of or application of the goods or materials;
5. any owner personally doing residential contracting work on his/her own home;
6. any individual who performs construction related labor or services for a home improvement contractor or subcontractor, for wages or salary and who does not act in the capacity of a home improvement contractor or subcontractor;
7. any contractor or subcontractor who works on one residential contracting undertaking or project by one or more contracts where the aggregate contract price to the owner is less than **$500**; provided, however, that the contract is not in an amount of less than **$500** for the purpose of evading 780 CMR R6 or M.G.L. c. 142A.
8. any person who engages in the business of a home improvement contractor or subcontractor on other than a full-time basis, and who has earned in gross revenues from residential contracting work, less than $5,000 in the previous 12-month period;
9. any person acting as a home improvement contractor or subcontractor who was enrolled as a full-time student in a secondary school or college with degree granting authority from the government of the state in which the school is located, for the immediately preceding academic semester and is also enrolled as a full-time student for the next academic semester, in the same or a similar degree granting secondary school or college provided that at least ⅔ of the number of employees of the contractor or subcontractor are similarly enrolled in secondary schools or colleges and that the home improvement contractor or subcontractor does not reasonably expect to earn or does not in fact earn, in gross revenues, more than $5,000 from residential contracting work;
10. persons who install any or all of the following:
    - central heating,
    - air-conditioning systems,
    - energy-conservation devices, or
    - provides conservation services conducted by or on behalf of a public utility under a program approved by the department of public utilities;
11. any contractor or subcontractor who works exclusively in any of the following home improvement areas:
    - landscaping;
    - interior painting or wall covering;
    - finished floor covering, including, but not limited to, carpeting, vinyl, tile, non-structural hardwood;
    - fencing or freestanding masonry walls;
    - above-ground swimming pools;

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